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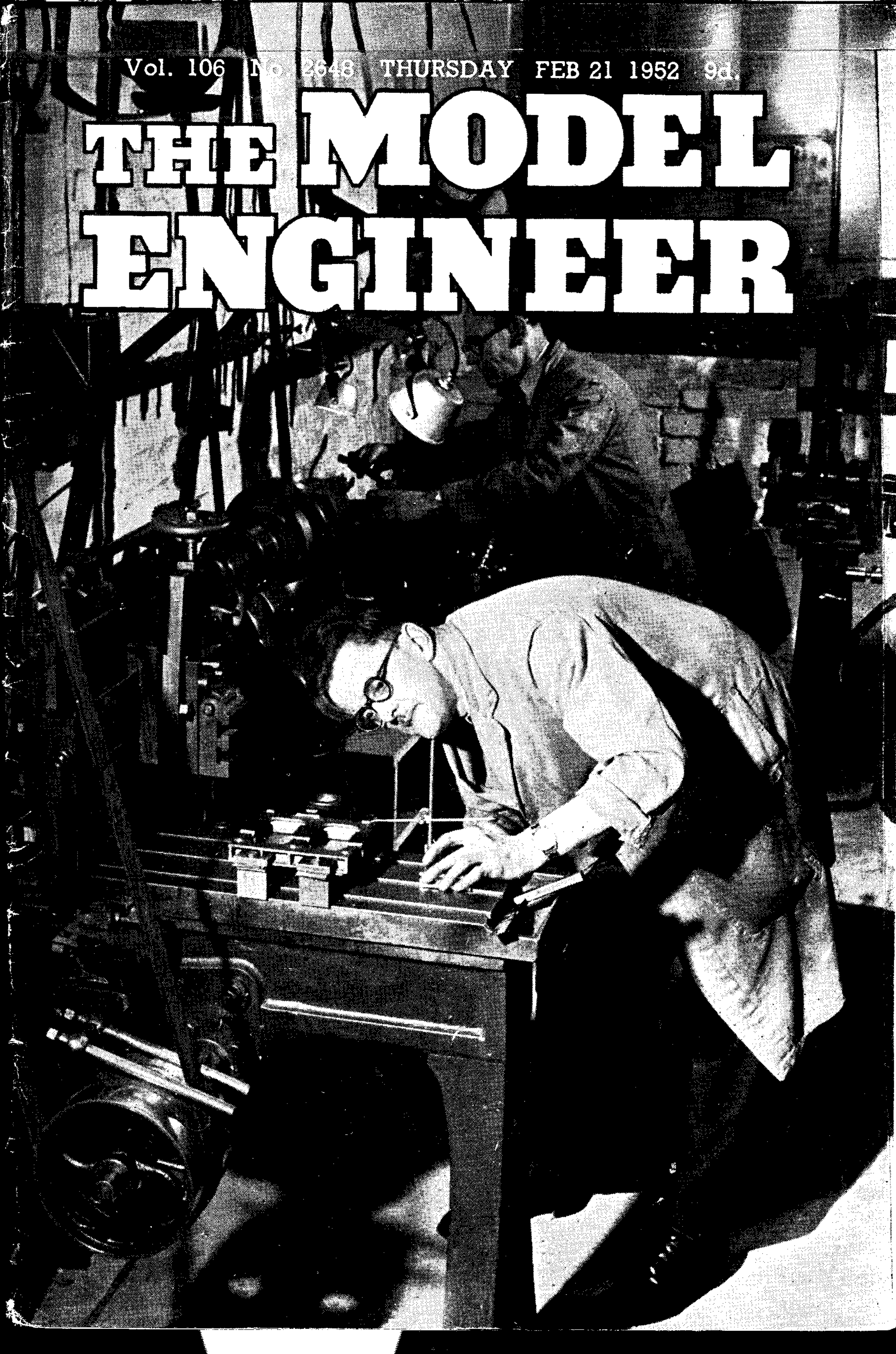
THE MODEL ENGINEER



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

21ST FEBRUARY 1952 VOL. 106 NO. 2648

SMOKE RINGS

King George VI

● THE SUDDEN death of His Majesty King George VI was a profound shock to the nation and to model engineers everywhere. The late King was well known as a lover of models and he seems to have been particularly interested in miniature locomotives. In the 1920s, when he was Duke of York, he made regular visits to the boys' camp at Dymchurch and usually seized the opportunity to spend some time on the Romney Hythe and Dymchurch Railway. He proved himself to be an expert driver and the possessor of a sound knowledge of railway matters. He possessed a number of models of various kinds and we recall an interesting model steam engine which he loaned to the Society of Model and Experimental Engineers and was on the society's stand at the "M.E." Exhibition that year.

His Majesty's interest in our railways was evident in the visits he paid to the railway factories, from time to time, which gave him the opportunity of making the acquaintance of railwaymen of all grades. A naval man by training, his chief interest was probably in ships and the sea, and his death will be keenly felt as a personal loss by all ranks in the navy, as, indeed, it is felt throughout the nation; for no monarch ever had his peoples' welfare more at heart than did his late Majesty, or worked harder in that cause.

Our Cover Picture

● WE RECENTLY had the pleasure of spending a most entertaining evening at the headquarters of the Society of Model and Experimental Engineers. Our photograph this week was taken on that occasion and depicts one of the members setting up a job on the planing machine. In the background can be seen another member at work on one of the lathes.

The S.M.E.E. are to be congratulated on their very fine premises, of which the above corner of the machine shop is but a small portion. Facilities include a well equipped fitting shop, test room with locomotive test rig and electrical dynamometer, library and lecture hall.

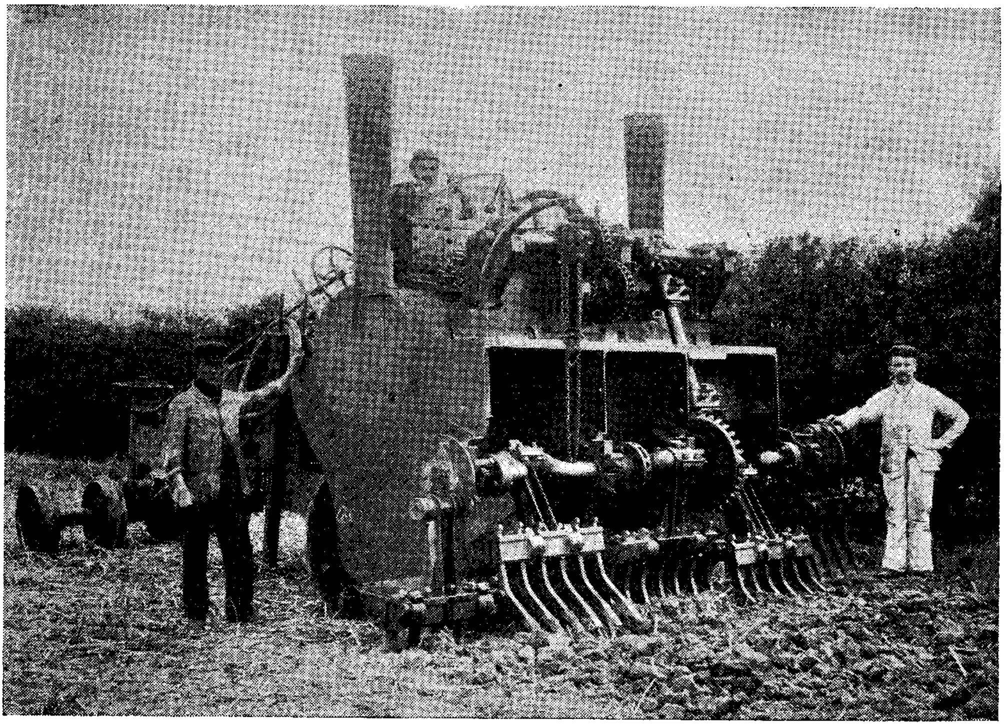
"New Engines for Old"

● READERS MAY be interested to learn that the engine which is the subject of the above series of articles by Mr. Edgar T. Westbury, now appearing in THE MODEL ENGINEER, is now on view in the window at 16, Great Queen Street, London, W.C.2. The display features not only the engine itself, complete with fuel and water-cooling tanks, silencer and belt-driven dynamo, but also some of the parts which were originally fitted, but have now been replaced by improved components, also photographs showing various machining operations involved in the reconstruction of the engine. In addition, the evolution of the articles from manuscript to publication, is demonstrated by selected exhibits. A good deal of interest has been shown among our readers in this series of articles, which have inspired

many of them to consider the possibilities of rebuilding not only old gas engines, but also other engines and machinery which have long remained idle. Many items of this nature, though crude and archaic in design, are quite capable of being brought up to date by similar methods to those which have been described in these articles.

The Darby Digger

● IN "SMOKE RINGS" for May 17th last, we published a photograph of a weird-looking contraption which many readers subsequently recognised as a Darby steam digger. Mr. John D. Elam, of King's Lynn, Norfolk, has kindly loaned us an old photograph showing an example of the Darby digger as built by Savages. There can be no doubt of this, because the plate on the steamchest cover immediately behind the near chimney reads: "F. SAVAGE, ENGINEER, KING'S LYNN, ENGLAND."



Because of its interest, we reproduce the photograph herewith, but it invites certain comments. In an old Savage catalogue, there is a reproduction of an engraved side elevation of a steam digger; this illustration is reprinted in the firm's centenary brochure and is described as "Darby's Broadside Digger as made by Savage." It shows what must have been a much larger machine than the one illustrated herewith; but the latter seems to be larger than the one we illustrated on May 17th. The catalogue illustration shows six "forks" as against only four in Mr. Elam's photograph, while our May 17th picture shows no indications of any "forks," suggesting that this digger was probably partially scrapped.

The Pioneer M.R.C.C.

● AT THE annual general meeting of the Pioneer Model Racing Car Club, which was held on Saturday, February 2nd, a strong vote was cast in favour of bringing to a close the activities of the club. Thanks to the foresight and initiative of certain members, however, a new committee was formed and a decision was made to carry on. This was indeed fortunate, as it would have been a great shame to see this, our oldest model car club, take the fatal plunge at a stage when model cars have reached a peak of mechanical development far in advance of the wildest dreams of the early pioneers, and are on the eve, as it were, of a new era.

Membership is now open, and meetings will be held in The Royal Horticultural Hall and at outdoor tracks. It will be part of the policy to encourage the construction and operation of scale models, but the club points out that it is essential that the necessary support be forthcoming.

All those who are interested, or would like further information regarding membership, are invited to contact the Hon. Secretary, Mr. A. N. Thorneycroft, 42, Brixton Hill Court, Brixton Hill, London, S.W.2.

"L.B.S.C.'s" Lobby Chat

"Museum-Pieces" as Passenger-Haulers

FROM time to time, correspondents write to ask if a small edition of a locomotive of the days of long ago, could be made to work satisfactorily, and haul its owner and builder. A letter received last week—time of writing—from Comdr. L. McCready, of the U.S. Merchant Marine Academy, Long Island, N.Y., brought to mind that I had promised to deal with this matter briefly in a lobby chat ; so let's do a little analysis, and make a few suggestions. The real old-timers of "museum piece" vintage, may be divided roughly into two classes ; the more-or-less conventional type, having a locomotive-type boiler mounted on a normally-wheeled chassis, containing the cylinders and motion arranged horizontally, or nearly so ; inside or outside, "makes no odds." The other class we might, for want of a better term, just call "freaks," including in the category such things as vertical boilers, cylinders, and weird and wonderful ways and means of transmitting the power to the wheels.

Now in the first class, practically every type could be reproduced in a small size, and made a working proposition, by means of a little jerry-wangling. The outside appearance could be a close representation of the original, in order to please our old friend Inspector Meticulous, and his friends and relations ; but the inside could be "modernised" for the sake of efficiency. An example of this kind of thing, is the *Rocket*-type engine *Rainhill*, which, as our regular readers will recollect, was fully described in these notes some ten years or so ago. The locomotive was a $3\frac{1}{2}$-in. gauge edition of the *Northumbrian* class, the last of the "cylinders behind" type built for the Liverpool & Manchester Railway. Scores of the little engines were built, all over the world, and they all did the job in the manner usually observed among efficient locomotives, despite their antiquated appearance. Many builders wrote and told me they were great favourites with kiddies, who had seen pictures of similar engines in the school history books.

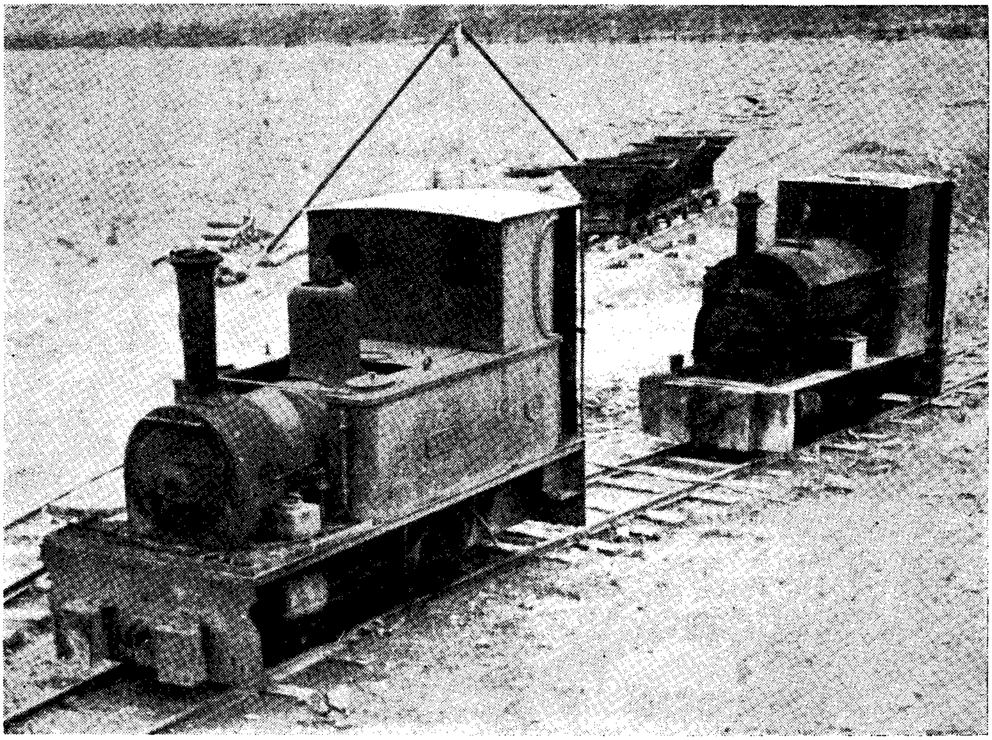


Photo by] [*P. T. Atkinson*

"*Tich*" *sisters* !

I might remind new readers, that if they wish to build a *Rainhill*, full sets of blueprints can be obtained from our offices.

Many "freaks" could be reproduced in the small size also, and some would be very interesting; for example, the Dundee & Newtyle 0-2-4 *Earl of Airlie*, which had vertical cylinders driving the leading wheels through a bell crank, and the South Eastern 4-2-0 *Folkestone* in which the cylinders drove a dummy crankshaft coupled to the trailing wheels by ordinary coupling-rods. As an example of a real working "museum piece," I don't know of one more interesting than Mr. Edward Adams's 2½-in. gauge *Puffing Billy*, which elbows its way around the Falls Grove Railway in a quaint and realistic manner, throwing a shower of miniature incendiary bombs from its long chimney.

A Suggested De Witt Clinton

Mr. McCready wants to build a one-eighth copy of the early (*very* early!) four-wheeled *De Witt Clinton*, and asks what variation would have to be made to enable it to haul a live passenger, or maybe more if feasible. He enclosed a full-sized drawing of the proposed engine and tender. Here is a case where neither external appearance nor dimensions need be altered. Although the engine is 7¼-in. gauge, with 6¾ in. driving wheels, the boiler is only 3¾ in. diameter; but the firebox wrapper is the same width, the bar frames being 5 in. apart, and the length of the firebox is 4 in. The capacity of this boiler is practically the same as that which I specified for the 0-6-0 tank engine *P. V. Baker*; and if the same arrangement of tubes is fitted, it would have no difficulty in steaming a pair of "scale" cylinders $\frac{11}{16}$ in. bore and 2 in. stroke. The old boy who designed the full-sized engine in the days of long ago, anticipated the Southern spam cans in his arrangement of smokebox, but he put his over the lower part of the barrel, just covering the tubes. He also had the wide chimney complex, for a "scale" chimney on the little engine works out at no less than 2½ in. diameter and 11 in. high, from top of smokebox! If a liner, say, 1 in. diameter and 4 in. long, is put in the bottom of the huge stack, the boiler would steam quite well, the exhaust "billowing" out in the approved old-fashioned manner.

The cylinders are arranged in the same way as I specified for *Rainhill*, and have small slide valves on top; but instead of driving on crankpins in the wheels, they drive like an inside cylinder engine, on to cranks set close to the inside of each frame. The full-sized engine had loose eccentrics, with the same system of hand reversing as was used in England; the driver disconnected the eccentric rod from the valve spindle by aid of a small lever, and moved the valve spindle by aid of another small lever, to the backward position. As soon as the engine moved back, and the stop caught the eccentric, he "dropped into gear" again. I can just imagine myself performing that antic during a night's shunting at Norwood Junction! However, on the little engine, the simple loose eccentrics specified for *Rainhill* would do the needful.

The quaint crosshead-driven pump of the original engine could be fitted, and would be a most interesting gadget. A short-stroke vertical pump was attached to the frame just behind the front wheels, and just above it was a bearing carrying the shaft of a bell-crank with long and short arms. The latter was connected to the pump ram, and the long arm connected to the crosshead, both by suitable links. Although the piston stroke of the little engine is 2 in., the bell-crank would reduce the stroke of the pump to about ⅝ in.

Another detail worth noting is the safety-valve, which is a marine pattern, with a separate escape pipe leading into the chimney; but the weighted lever of not-so-big sister would be very little use in the small edition, so a spring could be fitted to hold the valve down, in the usual manner. The lever, with an aluminium weight, could be added for appearance sake. The safety valve is located between dome and chimney—another anticipation!

Finally, there is the question of superheating the steam. On the original, the regulator or throttle was a glorified plug-cock affair, located on top of the firebox wrapper, with an outside pipe leading to each cylinder. This *could* be used as it is, as the engine would run on wet steam; but it could be utilised for superheated steam, by running a pipe from the cock, through the steam space of the boiler, to the smokebox tubeplate. Another pipe could be led from the top of the dome, to the smokebox tubeplate, and the ends of the pipes connected, either by flange joints or unions, to a superheater such as I specify for the boilers of modern type engines. The hot steam wouldn't cool off any more, going through the pipe in the boiler, than it does on the exposed steam pipes of *Rainhill*. No lubricators were shown on the drawing sent by Mr. McCready; the full-size job simply had tallow cups, but as hot steam demands plenty of lubrication, it would be an advantage to fit a mechanical lubricator under the footplate, feeding both cylinders, and driving it from an eccentric on the trailing axle.

British Types

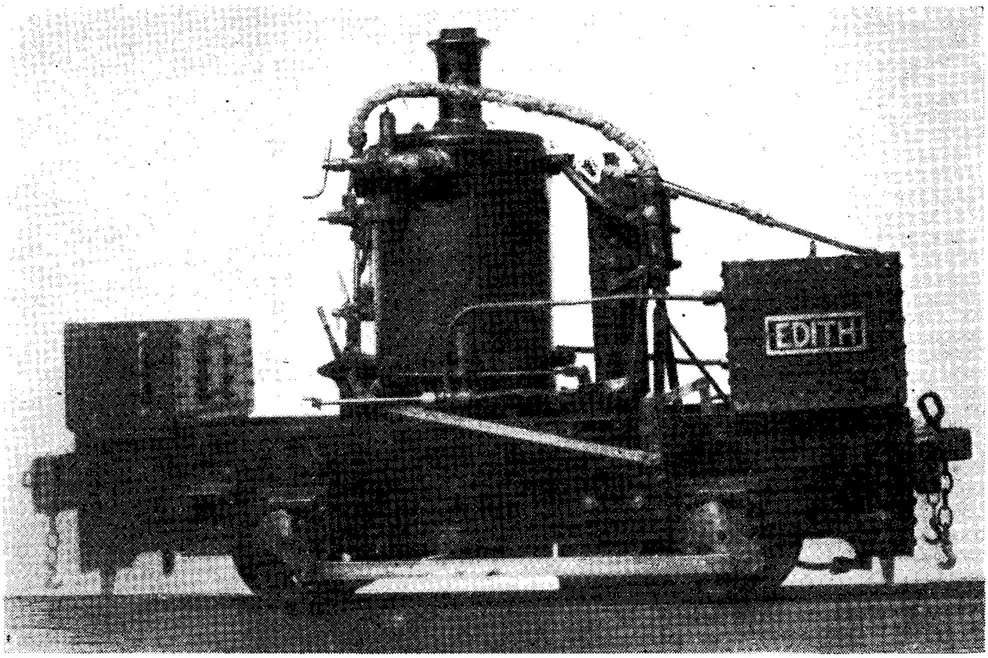
The old four-wheelers of *Planet* and *Samson* days, could be reproduced as passenger-haulers in 3½-in. gauge without external alteration. As a matter of fact, I have already got out dimensions, between whiles, for one of these engines; and if time, circumstances, and Bro. Bluepencil permit, will publish it along with the coming notes on the 3½-in. gauge "Canterbury Lamb"—old *Invicta*. I saw the poor old girl herself a short while ago. Like the famous quack doctor, she still stands in the market place, where she has stood for umpteen years, defying the British weather just as she defied Jerry, standing unhurt in the midst of the desolation after the big raid on Canterbury. Do you know what I would do, if I had as much cash as Lord Nuffield? Well, I'd buy the old engine and thoroughly recondition her. It would be a big job; she would, of course, need a new boiler and many new parts, but certain improvements could be incorporated, which would enable her to be made a first-class worker. Then I would have some "period" coaches made, have the old line put in order, and restart the

original train service between Canterbury and Whitstable, for the benefit of American tourists and others who make the "pilgrimage" to the famous city of Thomas a Beckett, and the "Red Dean." A certain party who shall be nameless, has never forgiven me for suggesting that if a spam can broke down at Canterbury, there was always a relief engine close to the station, to take the train on!

A Few Details

Anybody who peruses any of the locomotive history books containing illustrations of old-timers (Stretton's *Locomotive and its Development*, Ahron's *British Steam Locomotive*, 1825-1925, Sekon's *Evolution of the Locomotive*, etc.) will find a galaxy of old irons, some successful, some more or less N.B.G. the outlines of which may tickle their fancy; but whatever the not-so-big sisters did, or more often didn't, on the road, the little ones could be made top-notchers, simply by making their "works" conform to the principles set forth in my notes. No hot air intended, but gospel truth and a plain statement of fact; ask any *Rainhill* builder. The insides of the boilers should be made as nearly like *Rainhill's* as the diameter and length will allow; small variations in the size of firebox will not upset the efficiency, and the actual length of the barrel doesn't matter a bean. The *Planets*, *Samsons*, and similar four-wheelers had both axles in front of the firebox; and to adapt the *Rainhill* boiler to engines of this type, all that is necessary is simply to lengthen the barrel, so that when erected, the firebox comes behind the driving axle. The same type of boiler fittings can be used.

The cylinders of these engines were between 12-in. and 14-in. bore, and 16 in. to 18-in. stroke; and the small editions could be fitted with the kind of inside cylinders that I would specify for a modern medium-sized $2\frac{1}{2}$-in. gauge job, say about $\frac{3}{4}$-in. bore and $1\frac{1}{8}$-in. or $1\frac{1}{4}$-in. stroke. In fact, stock $2\frac{1}{2}$-in. gauge castings could be utilised, with distance-pieces between casting and frame at each side. Most of the old-timers valves were either on top or underneath, so the modern castings of this type would be just right. Talking about cylinders, you all know my ideas about the appalling waste of steam when huge cavernous passages are provided between port and bore. Well, Robert Stephenson & Co. found that out, 120 years ago, and got over the trouble by putting the steam ports near the ends of the steam-chests, with short direct passages to the bores. To avoid having a huge trench-like exhaust port between the steam ports, there were two separate exhaust ports, of moderate size, one for each steam port, and close to it. There were two separate slide-valves on the same spindle, with the correct steam lap on the end which slid over the steam port; the other end was merely long enough to keep the exhaust port covered at full extremes of travel. There is no need to go to the extra trouble of dividing the ports on a small engine, as your humble servant's



Ye Olde Coffee-Potte, by Mr. C. Wilkinson

design of ports and valves, compensates for it.

As to valve-gear, most of the four-wheelers had the loose eccentrics, with the hand-operated reversing device mentioned earlier. This isn't necessary on a little engine; it would be a dickens of a job to operate, anyway, and the simple loose-eccentric gear as described for *Rainhill*, would fill the bill, the eccentrics being placed between the cranks. This would be easy enough with a built-up axle. The boiler pump could be driven from another eccentric between the valve eccentrics—plenty of room for this, on a $3\frac{1}{2}$-in. gauge old-timer—or a crosshead pump could be used, as in the full-sized jobs.

Interesting Types

If any builder yearns for something out of the ordinary, cheap and easy to build, and a quick job withal (most folk lose interest in a long-drawn-out job; I do myself) there are several unusual old-time locomotives which could easily be copied, and would tickle the fancy of most folk. For instance, consider old Tim Hackworth's *Royal George*. Now she was one of the most successful of her time, and could be "modernised" without altering her personal appearance to any great extent. She was an 0-6-0 (the first engine of this wheel arrangement having outside coupling rods) with vertical cylinders mounted at the rear end of the boiler, directly above the trailing wheels, and driving direct on to them. The frames—courtesy title! —were just two straight bits of angle, with solid unsprung bearings for the driving axle, and a single leaf spring on each side for the leading and middle axleboxes. Had the driving wheels been sprung, she would have jumped up and down like a jack-in-the-box at every stroke of the pistons. The boiler was a plain barrel with a return flue in it, the chimney being set to one side. She had a tender at each end; the fireman operated from the chimney end, whilst the driver did his bit at the other, the water tank keeping him company.

This engine could be built "to scale" on $3\frac{1}{2}$-in. gauge, and should haul three adults without much trouble. This is how:—In place of the return flue, an ordinary firebox and tubes could be put in the boiler, which would be 10 in. long and $3\frac{1}{4}$ in. diameter. No smokebox would be fitted, but the front tubeplate set back $\frac{1}{2}$ in. or so from the end of the barrel. A flanged end plate would be provided, a push-in fit in the end of the barrel, and the elbow-bottomed chimney fitted into the front of this, at one side, same as on the full-sized job. The vertical cylinders would be $\frac{11}{16}$-in. bore and $1\frac{1}{4}$-in. stroke, mounted on bent-up sheet-metal brackets attached to the wrapper. The wheels would be 3 in. diameter, solid disc, with holes drilled in the webs to represent the appearance of the pre-spam-can wheels fitted to the original. These wheels would practically hide the firebox from the gaze of Inspector Meticulous; what the eye doesn't see, the heart doesn't grieve over! The valves could be driven by simple loose eccentrics; and a water pump arranged, same as in full size, the body attached to the side of the boiler, and the ram driven by a simple lever attached to the right-hand crosshead, and pivoted to a bracket on the boiler barrel, so as to reduce the stroke. A four-wheeled tender at the rear end, carrying a water barrel (the driver would be literally "on the water wagon"!) and another at the chimney end with some coal—and Tim's your uncle this time!

An engine which I'd love to see in $3\frac{1}{2}$-in. or 5-in. gauge, would be the 10-ft. 2-2-2 *Ajax*, built by Mather, Dixon & Co. for the G.W.R. in the early days. Both she and her twin sister *Mars* were, of course, complete "flops," and never did any useful work. The silly little 14 in. × 20 in. cylinders wouldn't have turned the ten-foot drivers to any purpose, even if the sillier little boiler could have made enough steam for the job; but in $3\frac{1}{2}$-in. gauge, there would be a different tale to tell! A $3\frac{1}{8}$-in. boiler, similar to old *Ayesha's*, would fit nicely between the huge driving wheels, and would easily steam a pair of cylinders $\frac{3}{4}$-in. bore and $1\frac{1}{2}$-in., or even $1\frac{3}{4}$-in. stroke. This boiler, and the suggested cylinders, would have no difficulty in turning the big wheels to some purpose, and keeping them turning, too! The full-sized engines' wheels were built up from boiler plate. To save having castings made, the little engine's wheels could also be built up, and it wouldn't be a difficult job, at that. For the ten-foot drivers, a piece of $\frac{1}{2}$-in. × $\frac{3}{8}$-in. steel could be bent into a circle $7\frac{1}{2}$ in. diameter; readily done if the steel is made redhot. The ends could be butted together, and a disc of 3/32-in. sheet steel cut to fit in the circle. In the middle of this, a boss, made from a stub end of 1-in. shafting, could be fitted. The whole lot could then be brazed up, and turned in the same way as an ordinary cast spoked wheel. Alternatively, *Maid of Kent* castings could be used, the front of the spokes turned away, also the tail of the pear-shaped boss; a thin plate could be fitted, to hide the spokes from outside view, and the effect would be the same as on the full-sized engine. However, proper castings could soon be made available if there should be any call for them.

These engines had double frames, consisting of straight bars, the horns for the leading and trailing axleboxes pointing downwards, and the driving horns pointing upwards; a simpler form of construction than a modern frame. The bars were joined by beams at each end, and some types had intermediate stays. On the small edition, only the outside frames would be needed. As the engines had no cabs, very little in the way of trimmings, and only short four-wheeled tenders, they would be ideal to handle on the usual elevated $3\frac{1}{2}$-in. garden railway. Another easily-built and handled, and very interesting type, would be the Bristol and Exeter 4-2-4 tank engine with 9-ft. driving wheels; a miniature "*Pearson's Pet.*"

I think the above about covers the points raised in various letters from readers interested in reproducing relics of the past as working propositions; as mentioned above, I hope to give a few constructional details of *Invicta*, and the *Planet* class, but if there should be a call loud enough to warrant notes and drawings of any other, I'd do my best to oblige, "by kind permission of the K.B.P." as the radio announcer would say.

*CAMERA DESIGN

An article of great importance to every reader whose interest centres on the field of photography

by Raymond F. Stock

THE twin lens reflex, increasing in popularity, uses a separate viewing lens immediately above the main lens, and by a mirror, produces an image for view-finding on a horizontal screen, as shown in Fig. 32. The upper lens is used always at full aperture thus producing a bright image, and focussing may be carried out by inspection of this image since the two lenses are linked together for focussing movement; depth of focus cannot be judged, of course.

A similar arrangement is used in cheaper cameras, but the upper lens is static (focussing being adjusted by scale, if at all) and often the ground glass screen is replaced by another lens so that the arrangement forms simply a large built-in " brilliant " viewfinder.

It will probably have been noticed that many cheaper cameras do not have a focussing movement. This is possible because a cheap lens is naturally of a small aperture and hence has a great depth of focus—a virtue from a necessity.

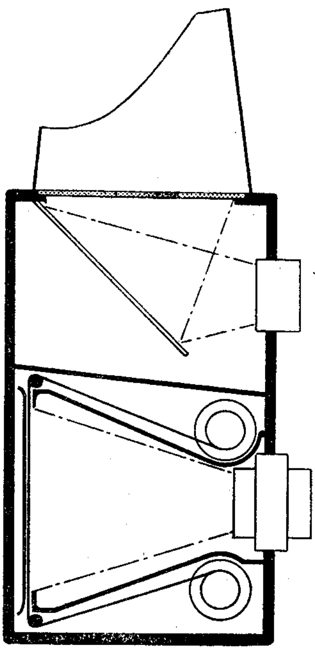


Fig. 32. Twin lens reflex

The lens is fixed in relation to the film so that all distances from infinity down to perhaps 9 or 10 ft. are within acceptable limits of sharpness, bearing in mind that negatives from such cameras are not likely to be enlarged to a great extent.

Additional lenses—" portrait " lenses—are sometimes used with such a camera, and enable a new distance (or range of distances) to be attempted: e.g., 3 ft. to 5 ft.

Film or Plate

The choice of plate or film to be used will obviously exercise a profound influence on the design of a camera.

Use of plates generally simplifies things, as film transport mechanism is obviated while no capping arrangements are necessary for focal plane shutters. There is no doubt that for photographing still life subjects, particularly models, a plate camera is ideal—exact focussing and placing of the object within the limits of view are possible, while results may be obtained quickly by developing one plate only, if desired, so that a retake can be made when necessary, almost on the spot. Plate holders or dark slides are obtainable fairly cheaply from second-hand dealers, and it is suggested that if a plate camera is to be attempted, the first step should be the acquisition of a dark slide of the appropriate size, and the lens. The rest of the camera should be designed around these units.

Where a general purpose camera is required, film is more convenient for most photographers and may be divided into backed roll film, 35 mm., and film packs. The latter are unlikely to be used by many photographers, for though having the advantage of individual development of pictures and less bulk than plates, they are more expensive and difficult to obtain than roll films. Roll films and their appropriate transport devices are too well known to require description. An old spool (from, probably, the local D. and P. chemist) is useful in the initial stages of design.

In the cheaper cameras, the film is virtually stretched across the focal plane between two rollers and prevented from arcing backwards by some suitable flat plane arranged behind it. Better cameras employ a spring-loaded pressure plate holding the film firmly against the framing of the focal aperture, and this pressure must be relieved during winding to prevent scratches on the celluloid. This is conveniently done by fitting a cam of sorts to the rear window cover, so that when the latter is lifted to allow the numbers to be seen the pressure plate is lifted away from the backing paper.

Some cameras use a dial counter to record the pictures taken, and if this is worked from the winder knob it is necessary to remember that the latter moves different amounts for each picture, due to the build up in diameter of the take-up spool.

Most convenient to handle is 35 mm. film as it may be advanced and metered by its sprocket

*Continued from page 214, " M.E.," February 14, 1952.

holes. It is, of course, most economical and seldom in short supply but many photographers find the picture size: 24 × 36 mm. too small.

If handled carefully in processing very good whole-plate prints may be made, but naturally when some enlargement is always a necessity there is less room for focussing errors.

The film may be handled in the camera in two main ways—it is either passed from one cassette to another (*vide* my article in THE MODEL ENGINEER No. 2622), or it may be passed from a pre-loaded cassette into a chamber in the camera (similar to another cassette, and fitted with a take up spool) and on completion of the film run back into the original cassette for unloading. Twelve, twenty-four and thirty-six exposure lengths of film are common, though almost any length might be used if desirable, with a suitably designed camera.

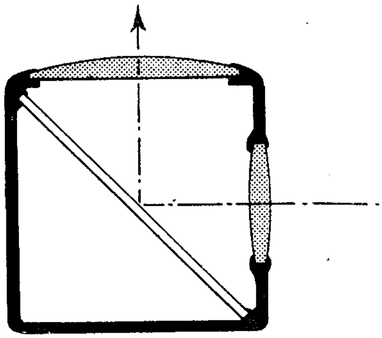


Fig. 33 (*a*)

The use of positive film transport by sprocket wheels facilitates operation and enables one easily to link the film wind with shutter setting (if any) thus employing only one knob and preventing double or nil exposures. Geared down or ratchet film counters are simply arranged.

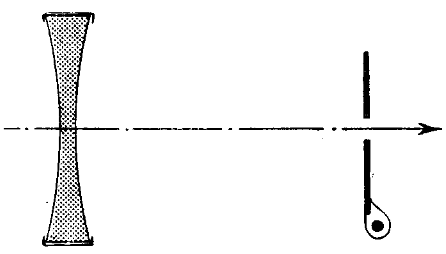


Fig. 33 (*b*)

Since the format is so small the general level of accuracy and workmanship must be higher in a 35 mm. camera. To protect the film some form of release must be fitted to withdraw the pressure plate during film wind if possible.

View Finders

In reflex and plate cameras the method of view-finding is inherent in the design. Other cameras need an additional unit for denoting the field of view.

The so-called "brilliant" view-finders fitted to many folding and box cameras use two lenses and a mirror to form a virtual image as shown in Fig. 33(*a*). The image is very small though it has the advantage of use at other than eye level: e.g., over one's head, in a crowd.

Another system uses a double concave or plano-concave—"reducing"—lens to form a miniature picture of the scene and this is viewed through a small aperture, as in Fig. 33(*b*).

A Popular Method

Probably the most popular method amongst amateurs is the frame finder—simply a small aperture to position the eye, and a wire or sheet frame having a suitably sized opening. If the small aperture is at the back of the camera (as is most convenient) the wire frame may be mounted on the lens panel when its size will be nearly that of the picture.

The axial distance between the elements may be reduced provided the size of the frame is reduced proportionately, but I consider that the larger the finder the better. The small rear hole need only be large enough comfortably to look through—about $\frac{1}{8}$ in.—and is not critical.

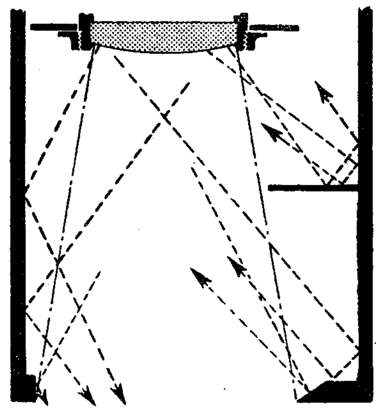


Fig. 34. (*a*) *Bad, and* (*b*) *improved arrangements for preventing internal reflections. The pecked lines indicate random emission of light from the back of the lens*

All finders should be checked by actual comparison with the picture at the focal plane using a ground glass screen to view the latter. The side of a house makes a good target and might be arranged just to fill the picture. Do not adjust the view-finder on a close object.

Any type of view-finder which does not lie coaxially with the taking lens is subject to naccuracies due to parallax; that is, the field of view seen is displaced to one side in comparison with that of the taking lens. This is negligible at distances above a few feet, but must be allowed for at short range. With experience, the view-finder may be "aimed off" the centre of the picture, but if an automatic device is desired the

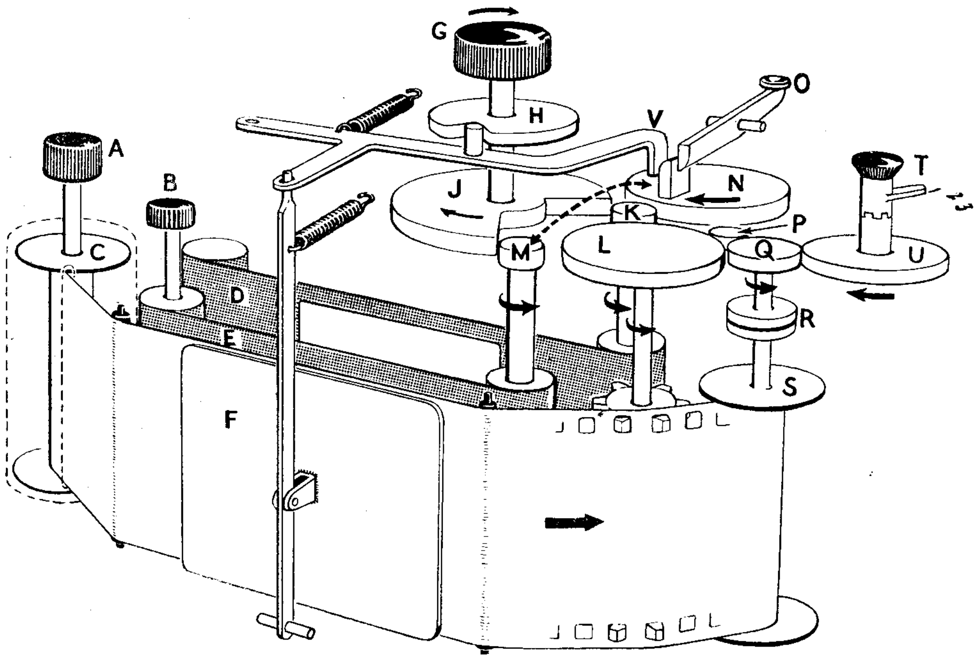


Fig. 35. Essential parts of a shutter and film wind mechanism, adaptable complete or in part to almost any size of camera. Arrows indicate direction of movement during winding : camera is shown set. **A**—*film rewind knob* ; **B**—*blind tension control* ; **C**—*rewind spool (in cassette for 35 mm.)* ; **D**—*capping blind* ; **E**—*exposure blind* ; **F**—*film pressure plate* ; **G**—*winding knob* ; **H**—*cam-operates* **F** *and shutter stop* **V** *during winding, and completes operation before* **J** *meshes with* **L** ; **J**—*gap wheel,* $\frac{3}{4} \times 48$ *teeth* $= 36$: *makes one complete turn and drives* **K, L, M** *in that order* ; **K**—*capping blind pinion—9 teeth* : 4 *turns* ; **L**—*film wind pinion—36 teeth* : 1 *turn* ; **M**—*exposure blind pinion—9 teeth* : 4 *turns. By gears omitted from drawing, it drives* **N** ; **N**—*shutter control wheel—36 teeth* : 1 *turn* ; **O**—*trigger* ; **P**—*film wind idler*; **Q**—*take-up pinion—24 teeth* : $1\frac{1}{2}$ *turns* ; **R**—*friction clutch* ; **S**—*film take-up spool* ; **T**—*exposure counter* : *reset by de-clutching* ; **U**—*counter gear—39 teeth* : 1 1/12 *turns (for 12 exposures)* ; **V**—*shutter stop* : *limits blind travel at end of exposure*

view-finder can be tilted boldily by a cam on the focussing knob so as to cause its centre line to coincide with that of the camera at the distance concerned.

Generally the smaller the film size, the less the displacement of the view-finder, and on many 35 mm. cameras no parallax adjustment is fitted. Very often in such cameras the obvious step is taken of combining view and range-finder and this is of great practical benefit.

Finishes

The exterior appearance of a camera is obviously a matter of taste ; the inside requires to be painted thinly with a good non-reflecting matt black paint, and gold size and petrol can be used as a medium to bind any opaque black pigment. It is essential to avoid a paint which powders or flakes, as any such dust gets on to the film eventually.

Parts subjected to friction such as film guides, pressure plates, etc., are best blackened chemically, or if this is unsuitable stove enamelled. Even matt black reflects some light, particularly oblique rays, and to minimise internal reflections from the camera body it is desirable to situate the walls of the box in which the image is formed some distance outside the limits of the plate.

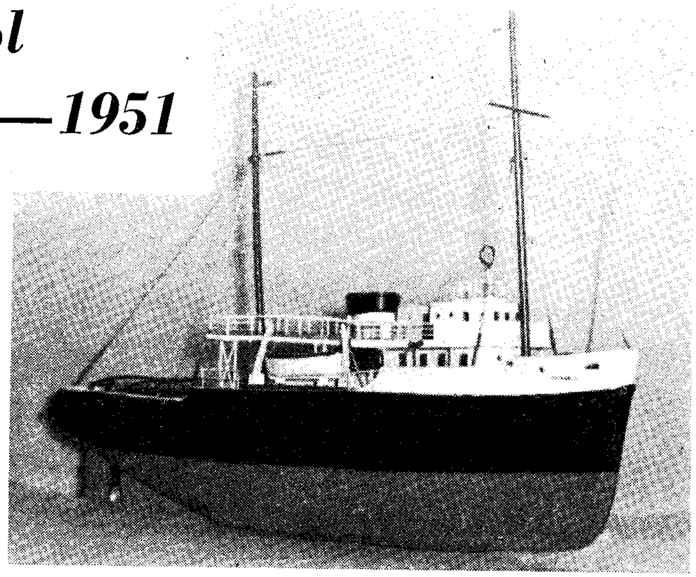
For the same reason, the edges of the aperture framing the film should be sharp, or bevelled on the front. An internal diaphragm cut just large enough to permit the image-forming rays to pass is also of assistance. Fig. 34 illustrates these points.

Conclusion

The design of a camera presents the same problems (within the limits of a few simple optical laws) as does any " orthodox " subject in model engineering, and the construction follows closely the same techniques ; furthermore a very serviceable apparatus can be made with much less specialised knowledge than is required for the efficient design of, say, an i.c. engine.

It follows that previous photographic experience is not essential to making a successful camera, and the mechanism becomes complex only when an attempt is made to fit the legendary quart in a pint pot ; finally, the more ambitious may be interested in Fig. 35 which shows the essential parts of a complete film-wind and shutter mechanism.

The Bristol Exhibition—1951


Mr. F. C. Watts' scale model motor tug, "Thames"

THE Bristol Joint Model Clubs' Committee decided early in 1951 to hold an exhibition, but where? After many enquiries a hall was found and arrangements put in hand, and after the usual trials the evening before the opening day arrived and, apart from one or two final touches the exhibition was ready for the Lord Mayor to open.

Four Bristol clubs took part and their members' efforts, together with many loan exhibits, caused some measure of overcrowding. Of the exhibits belonging to the Bristol Society of Model and Experimental Engineers, the locomotive section was outstanding; many fine models, finished and under construction, were on show, special notice being given to the locomotives which had given yeoman service on the society's track at Canford Park where 13,000 passengers had been carried during the past two summer seasons.

Another popular feature was the section devoted to models running under compressed air. A great variety of models were on show here. Locomotives, $3\frac{1}{2}$-in. to "OO" gauge, traction and stationary engines, vertical and horizontal steam engines, gave some idea of the wide scope of the many activities of this section.

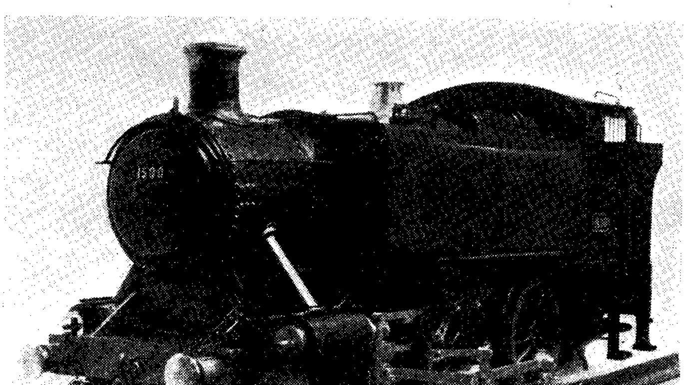
The Bristol Power Boat Club had on show several boats, and particular interest was shown in a radio-controlled air/sea rescue launch.

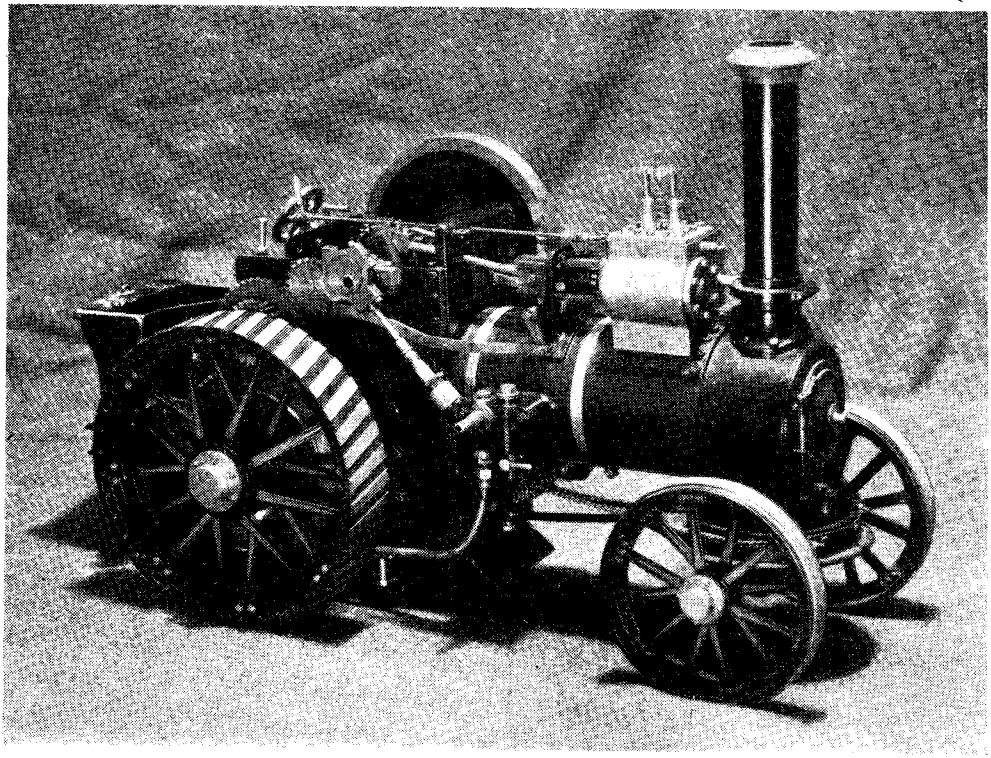
A separate section was given over to machine tools, of which a vertical milling and drilling machine with a swivelling head and compound table had been in use during the preparations for the exhibition.

This brief write-up would not be complete without the story of problems confronting the organisers of the exhibition in collecting the $7\frac{1}{4}$-in. gauge "Royal Scot" kindly lent by Mr. Phillips, of the Clevedon Model Club. The locomotive, weighing approximately 6 cwt., had to be manhandled by eight members from the end of the owner's track over part of his grounds to a lorry, and further strenuous work was called for to get the locomotive into the exhibition hall. The period of the exhibition gave time for thought as to how to organise the return journey. A rope cradle slung on steel tubes was the answer, and this trip was accomplished with comparative ease.

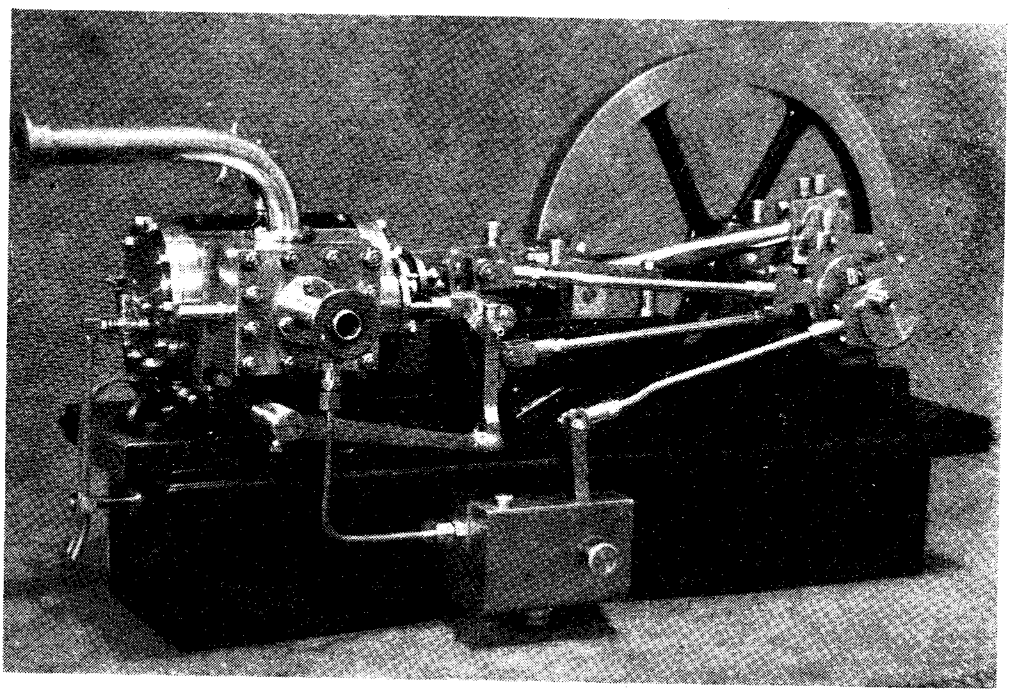
No model has been singled out for separate description, although many were worth a descriptive article in themselves; sufficient is it to say that the exhibition was a success, and the organisers and helpers had the satisfaction of knowing that their efforts had been worth while

—H.W.J.W.


Mr. F. C. Haigh's 5-in. gauge G.W. side tank locomotive, No. 1500 (unfinished)



Mr. J. Cayler's model single-cylinder traction engine on show at Bristol



A Bristol exhibit—Mr. H. M. Webb's model single-cylinder horizontal engine

PETROL ENGINE TOPICS

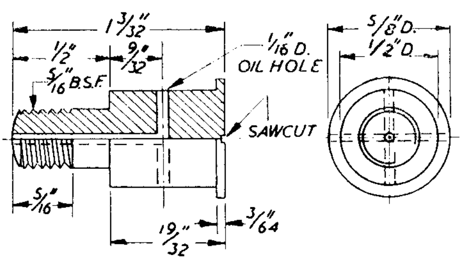
*"New Engines for Old!"

How an Ancient Gas Engine was Improved, Modernised, and Given a New Lease of Life

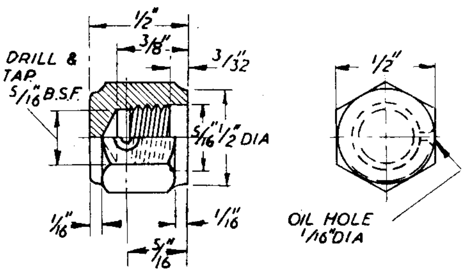
by Edgar T. Westbury

THE methods of cam forming which were described in the previous article are applicable to most types of four-stroke engines, and if any modification of the valve timing is desired it is only necessary to set out the angles on the division plate accordingly. Similar latitude is possible in the dimensions of the cam, including the lift, but it should be remembered that in any type of convex-flanked cam, the lift must not be excessive in relation to the base circle diameter, or the flanks will meet in a point, with no allowance for a radius at the tip. These details can easily be checked by setting-out the cam contour on paper, using as large a scale as practicable. It may be mentioned that the idea of providing "dwell" on a cam, to hold the valve full open for a period at the top of its lift, is not as clever as it sounds, as it can only be obtained (within the limits of a given angular period of opening) either by restricting the lift or by increasing the rate of both opening and closing of the valves.

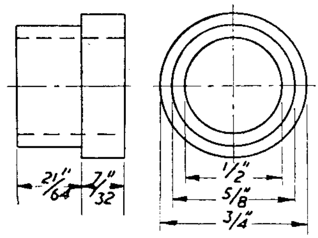
While the cam contours illustrated are not claimed to be ideal for high speed or high efficiency, they give quite good results, better in most cases than cams which have been shaped by rule-of-thumb methods, and also have the advantage of fairly quiet operation and good wearing properties, as they give a fair approximation to harmonic motion, and avoid heavy impact and shock loads.



IDLER PIVOT 1 OFF M.S.



IDLER PIVOT CAP. 1 OFF. BRASS



BUSH. 1 OFF. BRONZE.

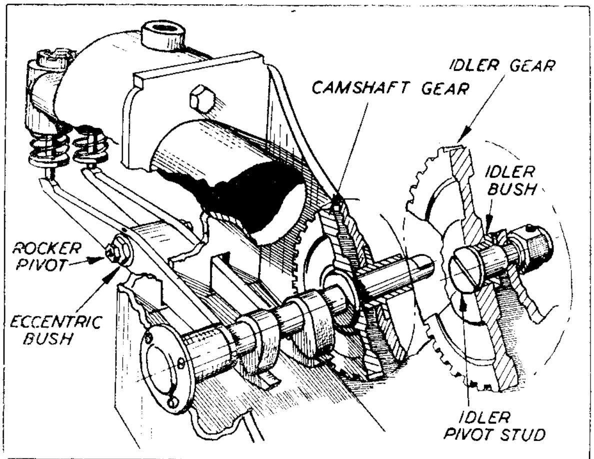
Idler Gear Pivot

As already mentioned, this is mounted on an intermediate stud, secured to the vertical web of the body between the crankshaft and camshaft bearings, but not in a straight line with them. The term "stud" is not strictly appropriate, as it is really in the form of a shouldered bolt, with a thin round head, slotted to take a screwdriver for the purpose of preventing it turning when the nut on the outside is tightened. It is drilled centrally from the small end, and radially four ways, to form oil passages. (As already mentioned, a bearing with the axle stationary can only be lubricated effectively from the inside.) The nut has a blind end, and also has a countersunk oil hole drilled in it for feeding oil into the stud; this hole must obviously be uppermost when the nut is tightened up, but the bolt being free to rotate, can be turned with the screwdriver into the right position and the four-way oil passages ensure that the oil will reach the bearing surface, whatever the angular location of the bolt may be.

While it is possible to set out the position of the

*Continued from page 173, "M.E.," February 7, 1952.

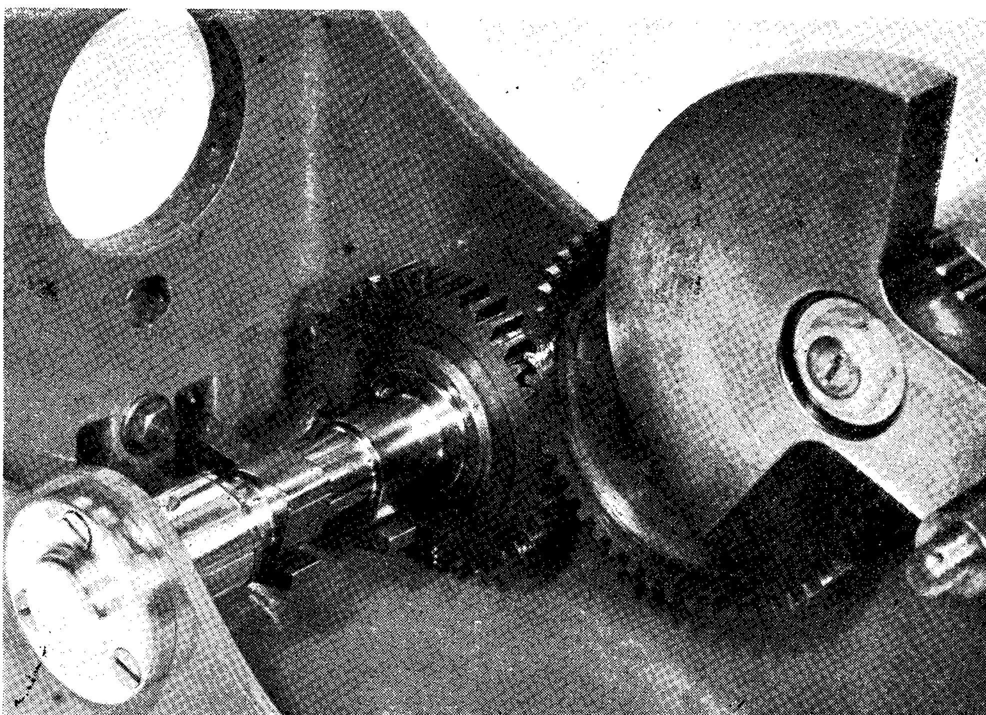
idler pivot in the web of the casting by careful measurement from the centres of the crankshaft and camshaft bearings, a more positive method of ensuring exact meshing of the gears was employed, and though the means for carrying this out may not be available in all cases, it may nevertheless be of interest to many readers who are faced with a similar problem. It happened that a milling machine was available, and so the body of the engine was set up on the table, with the crankshaft and camshaft in position, including their timing gears, and their axes lined up dead parallel with the spindle of the machine.



Cutaway sketch of valve-operating mechanism

A mandrel was now made to fit the socket of the spindle, and extended to carry the idler gear on its extreme end. By using the lateral and vertical movements of the table, the engine assembly was manoeuvred into position, so that the idler gear meshed up with the other two gears. The milling spindle was run at top speed, and final adjustment made until the gears ran quietly with the minimum backlash. Load was then applied to both of the driven shafts to ensure that quiet running was still obtained under these conditions.

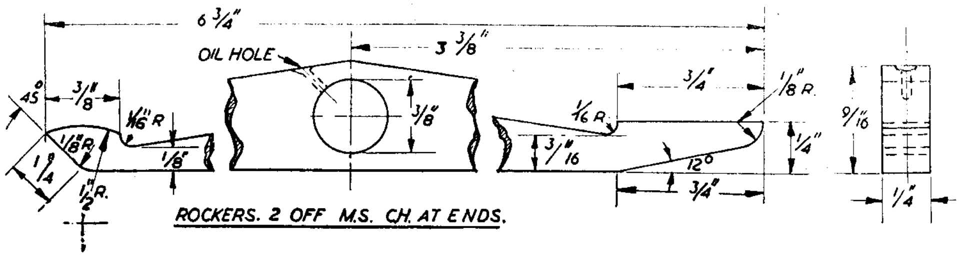
After ensuring that the mesh adjustment of the gears was as perfect as possible, the cross-slide of the table was run back, without disturbing either lateral or vertical movements, and the mandrel carrying the idler gear was removed from the spindle socket. Its place was taken by another mandrel, carrying a centre-drill in the end, and this was used to " spot " the hole in the web for the idler pivot-bolt. To ensure that the



View showing arrangement of camshaft and timing gears

drill which followed it was not diverted from its course by the rough surface of the casting, an end-mill was next applied, and after drilling, a piloted bar with a facing cutter was used on both sides of the hole to produce a seating dead square with the axis of the hole. All this, of course, had to be done without altering the table adjustment; and by using this method, it is practically impossible for the pivot to be other than in its correct place when fitted.

in this respect, as the three shaft centres are not located in a straight line. The 50-tooth gear, therefore, was fitted with a bronze bush, to run on the pivot stud, and it will be observed that the part of the bush which is pressed into the gear is shorter than the bore length by 3/64 in., so that the head of the stud is sunk flush with the face of the gear, so as to prevent it fouling the crank web and balance weight. The machining of the gear to narrow the tooth face is all on the



ROCKERS. 2 OFF M.S. CH. AT ENDS.

rear side in this case, so that it is offset from the hub centre to avoid fouling the web of the body casting; both this and the camshaft gear are recessed on the front and back to clean up the surfaces and remove unnecessary metal.

In the event of having to work to measurement, and a slight error in the meshing of the gears being subsequently found, it is possible to slot out the hole in the casting to correct this, but it is obviously much more satisfactory if the need for such an expedient can be avoided.

Timing Gears

The original gears fitted to the engine were of brass, and while this material may have been reasonably satisfactory for the loads likely to be encountered in a relatively low-speed engine (I have even known it to be used more or less successfully for the camshaft gears of racing engines) there was reason to believe that the gears were none too accurate in the first place, and they were showing signs of wear; moreover, an extra gear had to be found to serve as the idler. Had there been plenty of time available, we could have cut the gears in the lathe, using methods which have been described several times in THE MODEL ENGINEER; but it was hoped to have the engine ready for the 1951 "M.E." Exhibition, and time was getting rather short.

Fortunately, a source of supply of ready-made gears was available. The original gears were 20 d.p., and as readers are well aware, this corresponds to the pitch of the change wheels used on the Myford M.L.7 lathe, the makers of which willingly obliged by supplying a 20-tooth pinion (steel) and 40- and 50-tooth spur wheels (cast-iron). These are produced by precision methods on a gear shaping machine, and are thus above suspicion as to accuracy. It was only necessary to narrow the tooth faces down to ¼ in. to suit the space available, the strength of the teeth being ample to allow of this being done quite safely, and the bores, with their keyways, did not have to be altered at all.

As all readers familiar with the setting up of screwcutting gears know, the number of teeth in the idler gear do not in any way affect the gear ratio of the driving and driven shafts, and the size of this gear was selected only to give convenient spacing, some latitude being permissible

Setting the Timing

The camshaft gear need not be pressed fully home at first, as it will be necessary to remove it again after the position of the keyway has been determined. It may be put on in any position, as it will mesh up anywhere with not more than one tooth maximum error. The side plate, with the outer camshaft bearing, may be left off while the timing is being set.

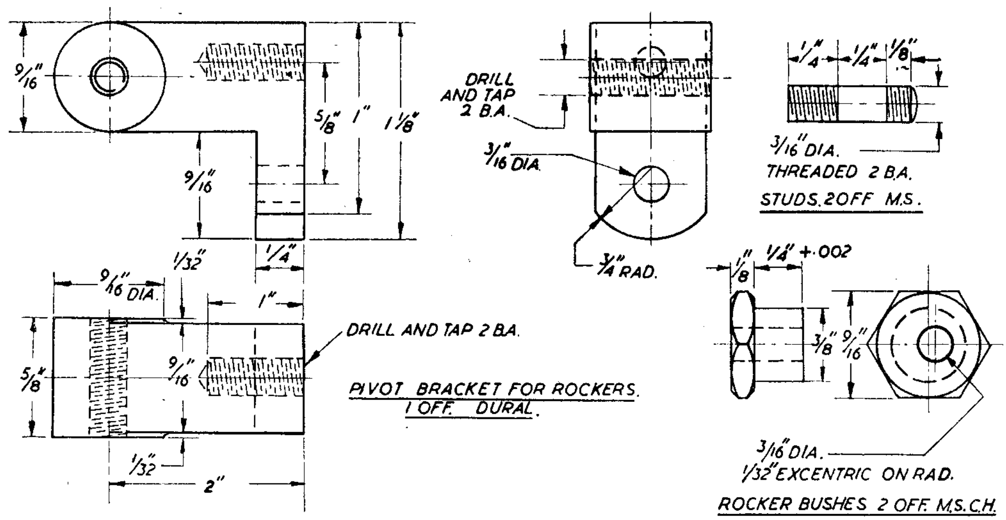
Assemble the idler gear on its stud, and the crankshaft in position, so that the pinion meshes with the gear, then turn the crankpin to the inner or "top dead centre" position. Before meshing the camshaft gear, turn it so that the witness marks on the collars of the shaft are exactly at the top. If, when in this position, the gear will not mesh up with the idler, it will have to be turned slightly, relative to its shaft; hence the reason for only partially pressing it on. When the correct position has been found, it will be possible to mark the position of the keyway on the shaft from that in the gear wheel.

This may be done by using a very small triangular needle file run in from the end of the keyway, close to each side of it in turn, so as to make two well-defined scratches on the shaft. Another method is to apply a drop of copper sulphate solution and allow it to remain for a few minutes, when it will leave a clearly visible copper deposit on the exposed area of the shaft. If this method is used, it should be carefully washed away after it has served its purpose, or it will set up rust at some time in the future.

The keyway is cut exactly on the marked position, either a half-round or flat key being suitable, but the former is not only stronger but usually easier to locate accurately. If a slight error is made in the location of the keyway, a stepped or "joggled" keyway may be fitted to correct it, but this expedient is best avoided if possible.

A certain amount of error in the timing of the events, up to about half a tooth or so, could be tolerated without making a great deal of difference to the running of the engine, but more than this would result in poor starting or loss of efficiency.

A final check on timing should be made after complete assembly; for the highest possible accuracy, a timing diagram in terms of crankshaft angle should be set out and attached to the flywheel, or marked directly on the rim of the latter. If by any mischance, a serious error is made in locating the keyway in the camshaft, it is permissible to cut one in a totally different place, as there are 40 possible positions in which the gears can be meshed. Although it is quite easy to time up the camshaft at any time after dismantling, by using the methods described, it is a good idea to mark the adjacent teeth on camshaft, idler and crankshaft gears so that they can always be replaced in the correct relative positions, with the least trouble.



PIVOT BRACKET FOR ROCKERS. 1 OFF DURAL.

STUDS. 2 OFF M.S.

ROCKER BUSHES 2 OFF M.S.C.H.

Valve Rockers

These are both alike, and are cut from ¼-in. mild-steel plate, the two pieces being temporarily sweated together for convenience in shaping them externally. They are mounted on the faceplate for drilling and reaming the centre hole, so that there is no question about this being square with the face, and the working surfaces at the two ends must be parallel with the pivot axis. It will be seen that the end which makes contact with the cam is dead straight, and both this, and the valve lifter end, are dead on the centre-line of the hole, but the latter is rounded to reduce any tendency to produce side thrust on the valve stem. Both the working surfaces are case-hardened and polished, but the centre is left soft, as the bush on which it operates is hardened. There would be no objection to case-hardening the rockers all over, but no means were available for heating them to an even temperature over the full length.

It may be remarked that long rockers of this type, although not the usual practice on any kind of i.c. engines, are by no means without precedent. They have been used on early motor-car engines, including the Lanchester and the Wolseley, and at least one well-known American racing car, namely, the Duesenberg, which was popular up to about thirty years ago. The inertia of the long arms is a disadvantage in high-speed engines, and in such cases they are made of "I" girder section to reduce this as much as possible, but the work involved in machining them to this section is hardly worth while in a low-speed engine.

Rocker Pivot Bracket

This is cut from duralumin, but steel or cast-iron would serve equally well. It is attached to the vertical back face of the main casting, under the centre of the cylinder; the original intention was to make it T-shaped, and secure it by set-screws above and below the extended pivot housing, but the space available was insufficient for this, and it has, therefore, been made L-shaped, the arm being disposed downwards to take a single set-screw, while the second one is put in from the inside of the body casting, through a clearance hole in the latter, and into a tapped hole in the back of the bracket.

The hole for the two rocker pivot studs was drilled and tapped horizontally right through the bracket, and by fitting the latter to a screwed stud in the lathe chuck, it was possible to face the sides dead square with the hole, and also relieve the surfaces outside the centre boss so that the rockers would not rub or foul.

Tappet Clearance Adjustment

Some means of adjusting the clearance between the rockers and valve stems, when the valves are closed, is very desirable, if not absolutely necessary, to maintain the efficiency of the valve gear under working conditions. In

large engines, the provision of an adjusting-screw and lock-nut in the valve lifter end of the rocker is often employed, but this is a clumsy expedient in a small engine, as "scale size" adjusting-screws are hardly practicable. Many of my engines have been fitted with eccentric bushes to the rocker pivots, which are much easier to adjust and more robust, while adding nothing to the inertia of the rockers.

This is the method employed here, the bushes being made of steel, with hexagonal heads to facilitate turning, and working on steel studs, with lock-nuts to clamp the bushes after adjustment. They are made a close working fit in the rockers, case-hardened all over, and polished. The exact amount of eccentricity in the centre hole is not critical, and can be obtained, after turning the outside, by setting the work over in the chuck for centring and drilling the hole. If the self-centring chuck is used to hold the work, a slip of sheet metal about 24-gauge can be inserted under one of the chuck, jaws; the amount of set-over will be greater than that accounted for by the thickness of the material, as it affects the adjustment of the other two jaws as well.

The rocker pivot studs are screwed at both ends, 2 B.A., and call for no special comment. At first the idea of making them hollow, for lubrication from an oil well in the bracket, was considered, but the position of the latter would make the oil well inaccessible, and in view of the fact that very little oiling is necessary, a countersunk oil hole in each of the rockers has been considered quite sufficient.

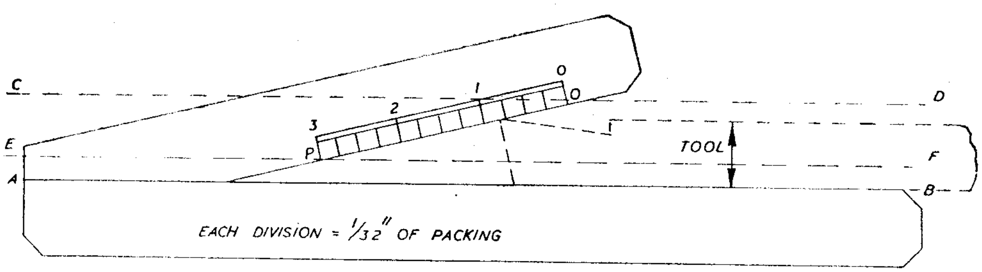
(To be continued)

Lathe Tool Height—How Much Packing?

by H. G. Sharpe

SETTING a tool to correct height in a lathe often takes time, especially when the work is of small diameter. The following suggestion may be useful.

Cut out of sheet metal, say $\frac{3}{16}$ in. thickness, a flat "V" with limbs of, say, $\frac{1}{2}$ in. width, diverging 1 in 8. Measure exactly the height between that part of the topslide on which the tools rest and the lathe centre, say, for example, that this is $\frac{3}{8}$ in. Find on one limb of the "V," call it the upper limb, the point where a perpendicular from the other limb, call it the lower limb, measures $\frac{3}{8}$ in. and mark it *O*. The top limb is now to be



graduated towards the apex of the "V" with whatever degree of accuracy may be considered desirable. If, for example, the tool is to be set with an accuracy of 1/128 in. there will be 48 divisions between *O* and the apex of the "V."

The tool shown in sketch may be made of $\frac{1}{2}$ in. $\times$ $\frac{3}{16}$ in. stuff, the inner edges being planed flat. This can be done on a small shaper, the longer leg in two steps using a small sensitive level. The joint is pinned and silver-soldered.

Perhaps the simplest way of making the gauge is to draw it full size first. The distance between *AB* and *CD* is exactly equal to that between the tool table of top slide and the lathe centre. Assuming that the maximum packing will not exceed $\frac{3}{8}$ in. *EF* is drawn that distance below *CD*. A convenient angle between the legs will be about 1 in 4, so at any point *O* on *CD* and with radius $1\frac{1}{2}$ in. ($\frac{3}{8}$ in. $\times$ 4) find point *P* on *EF*. *OP* is the length of the scale and produced both ways represents lower edge of upper leg.

In practice perhaps the upper leg should first be cut to conform to drawing and the extremities of the scale then marked on it. The scale can, of course, be marked in whatever units may be considered convenient and a set of packing-pieces marked on both sides.

The tool indicated on the sketch would require 7/64 in. of packing.

A hole bored in one of the legs offers a handy way of hanging it on, say, a leg of the bench.

The writer's gauge, a good time-saver, is in metric measurements, so the sketch does not depict a tool in being.

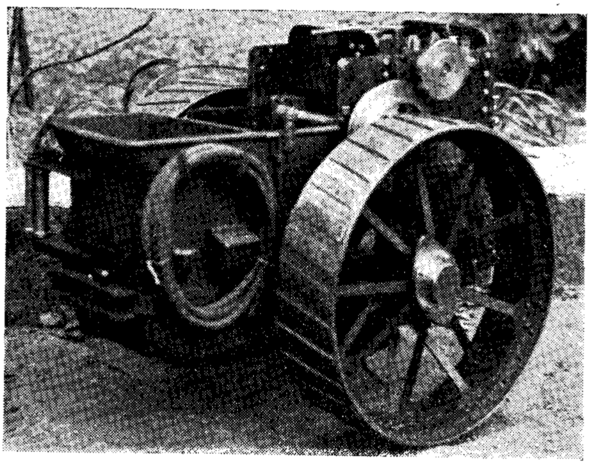
To ascertain the packing necessary, the tool is laid on the lower limb and moved towards the apex until the cutting edge touches the upper limb, at which point the thickness of packing required can be read off directly. Of course, the "V" need not be cut to its apex, as no tool is without height.

*The Allchin "M.E." Traction Engine to 1½-in. Scale

by W. J. Hughes

BEFORE starting on this instalment proper, I want to include two photographs from Mr H. Wilson of Glasgow, who is way ahead of the serial—in fact, he has progressed almost as far as he can, until the next sheet of drawings is ready.

If you will compare photograph No. 3 with photograph No. 2 (published with the first instalment), you will see that our Allchin really is going to look like the real thing, and that Mr. Wilson is making a grand job of her. Unfortunately, some of the detail on the photographs will be lost in reproduction, but I must say how delighted I was to examine them closely. You will note that the gears are not fitted to their centres—if they had been, the illusion would have been almost complete. Incidentally, these are the first photographs I have received of any model being built to the Allchin "M.E." design.



Photograph No. 3. A fine example of the 1½-in. scale Allchin being built by Mr. H. Wilson, of Glasgow

The Fowler "Big Lion"—A Disclaimer

One further interruption, before we can get on with the washing!

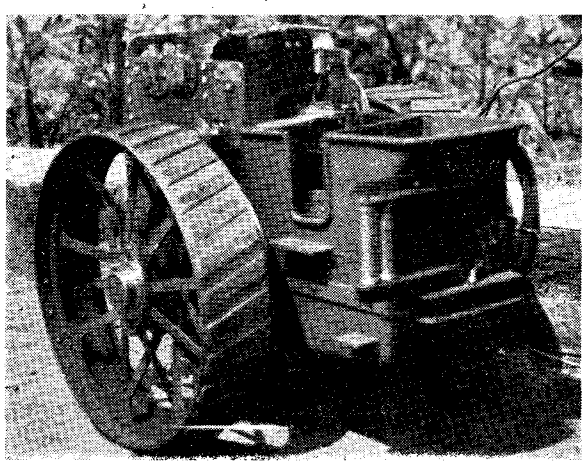
I am informed that some castings are on sale for the Fowler "Big Lion" Road Locomotive, and that they purport to be for a model to drawings being sold by Percival Marshall & Co. Ltd.

I feel it is my duty to point out that at the present time the only drawing of the Fowler "Big Lion" available from the "M.E." office is a General Arrangement Drawing of the prototype, and that no *detail* drawings are available yet (though it is hoped that eventually such drawings will be prepared). Meantime, however, the less experienced are advised to consider the amount of work involved in "translating" a general arrangement drawing of a prototype into a finished model, without detail drawings to work to. I can assure them it's quite a job, and that the Fowler is not the easiest engine in the world to tackle! *Verb. sap!*

More and More Holes!

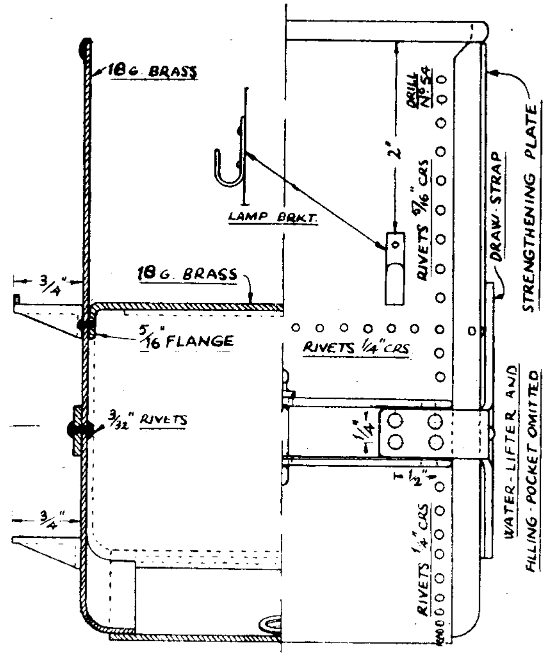
And now back to the Allchin. In making this tender your drilling-machine is certainly working overtime, but it's all in the cause of realism. For nothing looks worse than big rivets at large intervals where there should be small rivets at close intervals, and after all, riveting is not a difficult or a tedious job, especially done by the method to be described.

This time it's the back which needs setting out. First, square a line across for the "centre" row of rivets, which *must* come in line with those on the sides, of course. So measure one from t'other, and at the same time transfer the



Photograph No. 4. The other side of Mr. Wilson's Allchin. We think readers will agree that the model really does look "authentic," in spite of the unfinished state

*Continued from page 52, "M.E.," January 10, 1952.



Rear elevation and cross-section of tender

centre-line of the draw-straps to the backplate, and square that across. At 11/32 in. each side of this line, square two more lines; the draw-bar will fit between these.

The horizontal row of rivets is nominally at $\frac{1}{4}$-in. centres, but when marking them out, set your dividers to a gnat's whisker more than a quarter, so as to bring the end rivets $\frac{1}{8}$ in. from the edges.

Now with dividers or oddlegs, set to $\frac{1}{8}$ in., scribe the lines parallel with the edges of the plate for the vertical rows of rivets. Alter the dividers to $\frac{5}{16}$ in., and set out the rivets above the "centre-line" at this spacing.

Below this line, the joints have to be watertight, which explains why the rivets on the prototype are closer spaced than those higher up. We shall make sure of the water-tightness of our tender by soft-soldering the joints, but even so we'll copy big sister and set out the rivets at $\frac{1}{4}$-in. centres. Notice that *no* holes are necessary, or desirable, in the space to be covered by the draw-bar, and the first rivet below it is at a distance of $\frac{3}{16}$ in. In addition, at the left-hand side, there will be no rivets where the angles for the fairlead are bolted on.

All these holes should be drilled No. 54, to clear the 18-gauge brass wire from which our rivets will be formed.

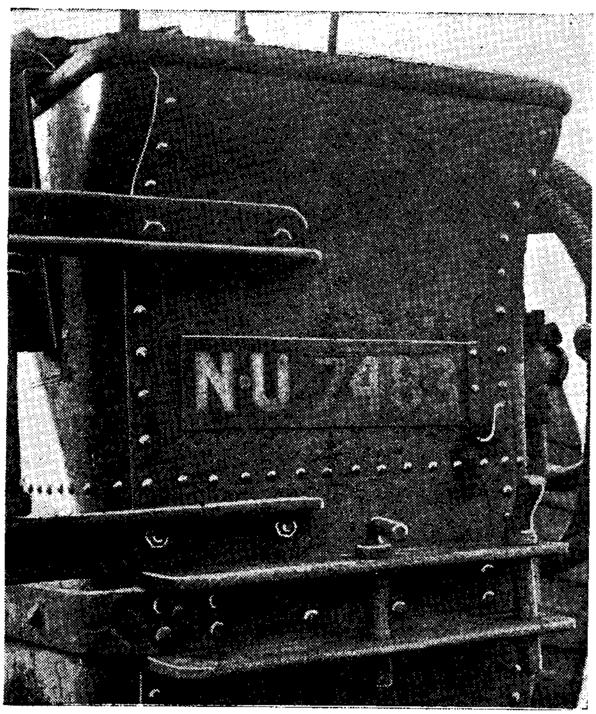
Assembly of Tender

We are now ready for the assembly of the shell of the tender—if you are like I am, you like to see things "put together" as soon as convenient—and the first step is to "tin" all the inside surfaces which are to be joined, so that the tank will be watertight.

Clean all the surfaces with emery-cloth, and anoint them with solder-paint. As most readers will know, this is a preparation of finely-ground soft-solder mixed with a liquid flux; usually an acid-flux is used, but non-corrosive solder-paints are available. My own personal preference for most work, however, is an acid flux.

Having painted the preparation on, heat the work with a blow-lamp, on a gas-ring or with a soldering-bit, until the solder runs. Wash off the flux, either with water or with a cloth moistened with methylated spirits (my preference again) and there we are. Of course, you may prefer to tin the surfaces in the ordinary way, using a soldering-bit, stick solder, and flux, but the paint method is much quicker and easier, in my opinion.

Take the tank-top, or footplate, and on each flange scribe a line $\frac{3}{16}$ in. from the *top* of the footplate. Incidentally, see that this plate is really flat before you go any further! Then take the right-hand tender-side, and clamp it to the flange of the footplate, making certain that the centre-



Photograph No. 5. Back of the tender of the prototype. Note the drawbar, with the ends of the drawstraps overlapping: the angle-irons for the fairlead: and the water-lifter. The second draw-bar pin is not standard

line you have just marked lines up exactly with the centre-line of the rivet-holes, and that the rearward flange of the footplate comes exactly level with that of the tender-side. Toolmaker's clamps are best to hold the pieces together. If you haven't any, our friend "L.B.S.C." has several times described how to make them quickly and easily.

Making a Rivet-Set

If you haven't a suitable-sized rivet-set, the making of this had better be the next job, because we shall need it very soon now. Take a $2\frac{1}{2}$ in. or 3 in. length of $\frac{5}{16}$ in. or $\frac{3}{8}$ in. diameter silver-steel, and face the ends in the lathe. Using the very tip only of a biggish Slocombe drill, make a small countersink in one end, and enlarge it with an ordinary drill until the countersink is 5/64 in. across.

Have a 3/32-in. diameter steel ball ready on a good solid surface, and heat the end of the steel to bright red. Put the counter sink on top of the ball, and clout the other end good and hard with a hammer. You will now have a nice nearly hemi-spherical depression in the end, but if it isn't deep enough, heat it up again and repeat the operation. Allow the steel to cool slowly, put it back in the chuck, and turn the taper on the end. If necessary, take a skim off the end, as the head of a rivet should be a little less than a hemisphere. Round off the corner slightly, and polish with emery.

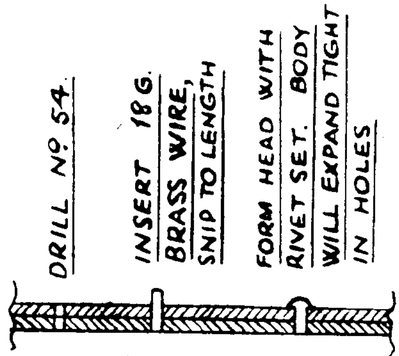
To harden the set, heat the steel to "cherry" red—that is, pretty bright—and plunge endwise into tepid water, giving it a swirl at the same time. The tool now requires tempering, so brighten the taper with emery-cloth. Re-heat the shank of the set, and you'll see bands of colour creeping up towards the tip, from light straw colour through brown to blue. When the dark straw or light brown reaches the tip, plunge the tool into the water again, and it's ready for use.

Forming the rivet-set

Now having clamped together the tank top and the tender side, start to drill the holes right through, using the already drilled holes in the side as a jig. Only drill one or two holes at a time, then insert the rivets and head them. If you drill all the holes at once, and then start riveting, you may find by the time you've inserted several rivets that one or other of the pieces of metal has "crept" slightly, so that the holes don't coincide. So start from, or close to, both ends, then put one or two in close to the middle, then one near the middle of the remaining spaces, and so on.

You will need a stout piece of square or rectangular section bar to act as a "dolly" or "stiddy" —I use a length of old wrought-iron railing of about 1 in. × $1\frac{1}{4}$ in. section.

The method of riveting is as follows—and it may be as well to practice on a bit of scrap sheet first, especially if you are a tyro. Take a few inches of 18-gauge brass wire, rub one end square on a very smooth file, and insert that end in the hole. (The job will be resting on the dolly, of course, which is firmly gripped in the vice.) Snip off the surplus wire, leaving about 3/32 in. standing above the tender side. The actual length left standing depends on several factors, not the least of which is the shape of the jaws of your cutters—that is why I advise a trial first!



Three stages in riveting the tender

Rub the projecting end with the file to remove any sharpness; then place the rivet-set on top of it, and tap it two or three times with a hammer to form the head. Go easy at first—you'll soon learn by experience how hard to hit and how many blows are needed. If you hit too hard you'll bend the rivet sideways, and if you hit too often the end of the set will mark the tender side!

What's that? Won't the rivet be loose in the hole? And isn't it necessary to form a head on the other side? To which I reply it won't and it isn't. For as the head is formed the body will swell, and will fit the hole so tight that it can only be punched out or drilled out. And this, coupled with the sweated joints, will prove amply strong for our purpose. Of course, if you like, you can insert proper $\frac{1}{16}$-in. rivets from inside, and head them outside, but really it isn't necessary.

Like so many other jobs, this riveting takes far longer to describe than to do, and it will be found that with the tools all to hand, and laid out in order, a couple of dozen rivets can be put in in very quick style.

Incidentally, I should mention that this method was first brought to my notice some years ago by Mr. N. E. Nicholson, who is now President of the Sheffield & District S.M.E.E.

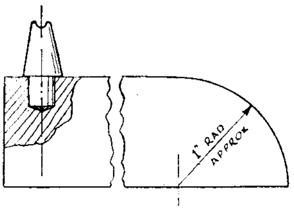
Tender Assembly (Continued)

Continuing with the assembly, the coal-plate may now be placed in position, clamped, and riveted to the tank-top and tender-side. The rivets in the side may be $\frac{1}{16}$-in. rivets with the heads inside, if you like; in fact, they should be, strictly speaking, as they will be visible when

there is no coal in the tender. In this case you will need another rivet-set to support the head inside while you use the first set to form the outside head.

The new set can be about an inch long overall. Having formed the cup on one end, and before hardening, turn a shoulder $\frac{1}{8}$ in. diameter on the other end, to fit in a $\frac{1}{8}$-in. hole drilled close to the end of the dolly (*see* sketch). Then turn the taper, and harden and temper as before.

Having fitted the coal-plate, the left-hand tender side comes next. When it is clamped in



Showing the "inside" rivet-set mounted in the dolly: and the end of the latter radiused as mentioned in the text

position, and before drilling any holes, check it carefully to see that its edges exactly coincide with those of the right-hand side. Then carry on with the riveting, but, as I have already remarked, do not insert any rivets where the upper footstep comes. Note also that on this side the rivets holding the coal-plate have countersunk heads outside, otherwise they would be in the way of the beading round the driver's entrance.

Following this, the back of the tender is fitted. However, as the bottom has to fit up flush to it when it is in position, it is desirable to have a strip of brass $\frac{1}{2}$ in. wide fitted over the inside of the joint, overlapping back and bottom by $\frac{1}{4}$ in. each side of the joint. This strip will be $3\frac{1}{16}$ in. long, and should be riveted to the bottom edge of the back, having been tinned first.

Again, in riveting the back to the sides, the rivets should be round-headed inside, above the footplate, although those below may be inserted as previously described, of course. By the way, in order to head the rivets on the lower curve of the back, it will be necessary to file off one end of the dolly to a suitable curve.

You can now fix the dummy manhole cover to the left-hand tender-side, using eight No. 10 B.A. brass screws—half-round ones will do—with the nuts outside. Tin the heads first, and also around the holes inside.

Sweating the Joints

While the bottom is still unfixed, it will be easier to sweat up the joints already made, so that's the next job. If you have a nice hefty soldering-bit, you can use that to heat the joints, with a stick of solder handy, but because of the bulk of the job, and the fairly high conductivity of brass, it will be advisable to preheat the job over a gas-ring or with a blow-lamp. Of course, you can do the whole job by external heating, without the bit, but the latter enables neater joints to be made, and even if they never *will* be seen, you'll know yourself that they're there! Besides, unless all the joints are the close fit that they *should* be, it's surprising how much solder can run through to the outside!

The way I did mine was to put the job on a gas-ring, with the jets turned down low, so that it never got quite hot enough to melt the solder. Then, with the bit heated, each joint in turn was painted with Baker's fluid, and the hot bit applide to the joint with, if necessary, a little extra solder in places. Since my joints fitted decently, very little solder was needed to make watertight joints, but I made an application of solder paint over the inside ends of the rivets to make absolutely sure that they were watertight. You should also see that the inside ends of the screws which secure the manhole are well sweated over.

Now proceed carefully to wash off all the flux—use a small scrubbing-brush or a cast-off stiff-bristled toothbrush to get in the corners, and we're ready for the next job.

Oh, by the by, quite a number of people don't know this little tip. When you've been using acid flux, wash the hands well under running water *before* applying soap. It stops that nasty black slimy stuff forming instead of the lather! And if your face is tender, and the acid fumes have made the skin smart or prickle, a rinse in water without soap will remove the irritation.

(To be continued)

Allchin "M.E." Traction Engine Castings

We have been able to inspect some castings produced by Mr. John Mackay, Milton Mill, Whins of Milton, Stirling, for the Allchin "M.E." traction engine, now being described by Mr. W. J. Hughes periodically in our pages.

The castings are in good-quality iron, reasonably clean and accurate to size, and we commend them to the attention of all potential builders of this pleasing engine; they have been made from plate patterns. A complete list of them can be obtained by sending a stamped, self-addressed envelope to Mr. Mackay at the above address.

IN THE WORKSHOP

by "Duplex"

No. 109.—Using Calor Gas

WHERE town gas is not installed in the workshop the workers have usually to fall back on paraffin brazing lamps and methylated spirit heaters for hard- and soft-soldering. Although methylated spirit lamps of the laboratory pattern may serve quite well for soft-soldering, and a blowlamp provides adequate heating for some brazing work, there is no doubt that the dirtiness and uncontrollability of the paraffin lamp renders it unsuitable for delicate work.

Equipment that uses a clean fuel of high-calorific value is, therefore, a great convenience and of some importance to many workers. Calor gas is a fuel of this type. It is a mixture of volatile hydrocarbon gases that liquify at comparatively low pressures. These gases are formed as by-products during the refining of crude oil for the manufacture of petrol.

Coal gas has a calorific value of 450-500 British Thermal Units per cu. ft. In comparison the calorific value of Calor gas is 3,250 British Thermal Units per cu. ft.

The gas has no harmful effects on the appliances with which it is used, it is not poisonous and it contains no poisonous constituents.

In general, on a thermal basis, Calor gas is three times as expensive as paraffin and twice as expensive as town gas ; because Calor gas is so much more convenient to use, however, the makers claim that the comparison is reduced to $1\frac{1}{2}$ times the cost of paraffin oil.

There is, of course, no convenience factor to take into account when comparing the gas with town gas. The cost comparison, therefore, remains as previously stated : that Calor gas is twice as expensive as town gas.

Gas Storage Cylinders

Calor gas is a fuel which is stored in liquid form in steel cylinders at an approximate pressure of 25 p.s.i. These cylinders are supplied in several sizes each provided with a screw-down valve for controlling the supply of gas. The two sizes of cylinders suitable for workshop use hold 83 lb. and 32 lb. of the liquid gas respectively. The dimensions of the cylinder containing 83 lb. of the fuel are approximately $12\frac{1}{2}$ in. dia. × 48 in. high and the 32 lb. container measures $12\frac{1}{2}$ in. dia. × 18 in. high. As the gas is stored in liquid form the supply of gas from the cylinder delivery valve is dependent upon the evaporation of the liquid within the cylinder. This evaporation will cease if the temperature of the air surround the cylinder is below the boiling point of the liquid, or if the rate at which gas is drawn off from the cylinder is greater than has been provided for. The evaporation is dependent upon the transfer of heat to the liquid through the walls and base of the cylinder. In the two sizes of cylinder mentioned above this heat transference is sufficient for normal workshop purposes.

In estimating how long the contents of a cylinder will last it may be well to note that 1 lb. of liquid Calor gas is equal to $6\frac{1}{2}$ cu. ft. of the gas in the vaporised condition. The boiling

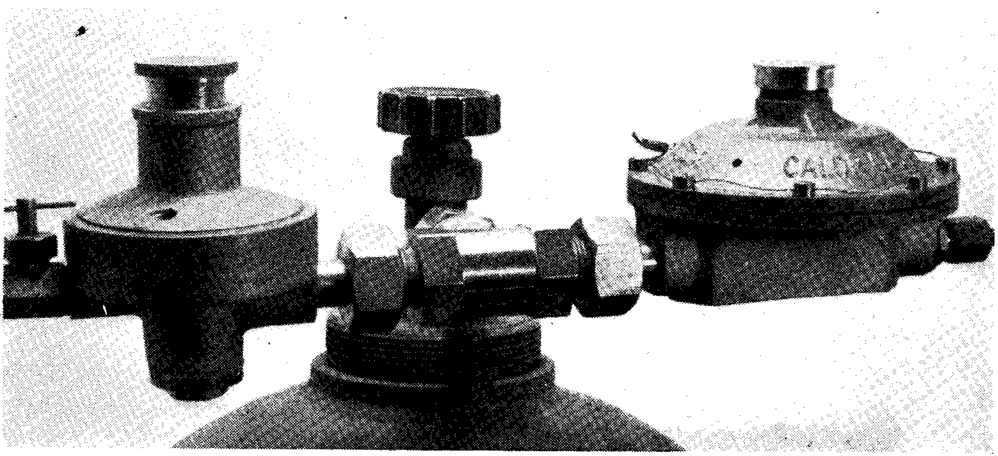


Fig. 1. High and low pressure regulators

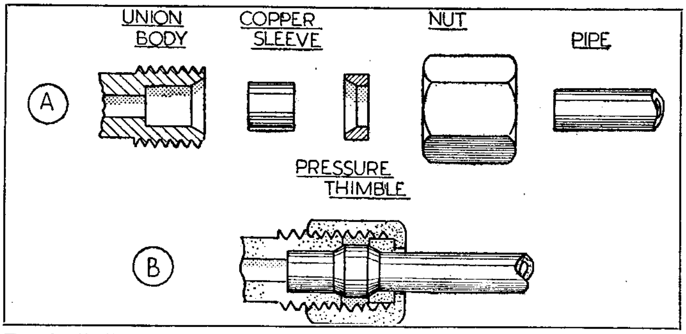


Fig. 2. "A"—component parts of the union ; "B"—the union in section

point of the liquid in a Calor gas cylinder is approximately 30 deg. F. It follows, therefore, that difficulties may arise in obtaining a supply of gas if the cylinders are stored out of doors in frosty weather. Calor gas stockists often receive complaints from caravan dwellers that they can get no gas in cold weather ; inspection of the installation usually reveals that the cylinders themselves are in the open and that there had been a frost at the time when no gas supply could be obtained.

The contents of a cylinder containing Calor gas may be estimated either by direct weighing, or, in cold humid weather, by observing the line of condensation on the cylinder. The first method, however, will be found to be the most satisfactory. The weight of the cylinder itself is stamped upon a panel affixed to its upper surface. As the weight of the liquid when the cylinder is full, is known, there is no difficulty in calculating how much gas remains in the cylinder. All that is necessary is to subtract the weight of the empty cylinder from the combined weight of the cylinder and its contents. At no time should gas be drawn from the cylinders when they are lying on their sides. Nor should they be installed near stoves because of the fire risk.

Reducing Valves

Because Calor gas appliances are not designed for high pressures, it is impracticable to use Calor gas at the pressure at which it is stored in the cylinders and two types of suitable reducing valves are, therefore, supplied. These reducing valves are of high-pressure and low-pressure types. The high-pressure valve is controllable by the operator and may be set to regulate the pressure from 2-6 p.s.i. but the low-pressure reducing valve is pre-set by the manufacturers to deliver gas at 11 in. water gauge pressure and is not adjustable. Both these regulators are illustrated in Fig. 1 where the H.P. regulator is seen on the left. It will be observed that the regulators are attached to a T-piece connector designed by and obtainable from the Calor Gas Co.

Piping Connections

Metal piping for use with Calor gas should be made of copper and no soldered unions should be employed ; instead, the special type of solderless connectors recommended by the Calor Gas Co. should be used. This union was described in an article entitled "Pipe Fittings," published in THE MODEL ENGINEER on June 29th, 1950, and is a most convenient and practical form of fitting. As will be seen from the illustration (Fig. 2A) the union consists of four parts. The union nut screws on to the body and carries with it the pressure thimble. This thimble squeezes the copper sleeve, which is slipped over the pipe, and crushes it on to the copper pipe, so making a gas-tight joint, as illustrated in Fig. 2B. When both high- and low-pressure regulators are attached to the gas cylinder, it is essential to provide well-made taps to control the gas supply ; these may be obtained from the Calor Gas Co. through their agents both in the United Kingdom and in Southern Ireland.

Taps of the type sold for town gas control are suitable for gas at lower pressure. But it has been found that the needle valve form of tap is better for dealing with Calor gas at high pressure. The tap described in "Pipe Fittings, published in THE MODEL ENGINEER on July 13th, 1950, has been used with success in this connection, for it was originally designed for just such an application.

Two varieties of rubber hose are supplied for use with Calor gas. The high-pressure hose is of rubber-canvas construction with a bore of approximately $\frac{3}{16}$ in. dia. The low-pressure hose is all rubber and has a bore of $\frac{5}{16}$ in. dia. The Calor Gas Co. supplies these hoses and they may be obtained from any of the Calor gas stockists. If hoses are obtained from other sources care should be taken to see that the hose purchased is made to resist the action of butane or, alternatively, is resistant to petrol.

Hose sold for use with town gas is unsuitable.

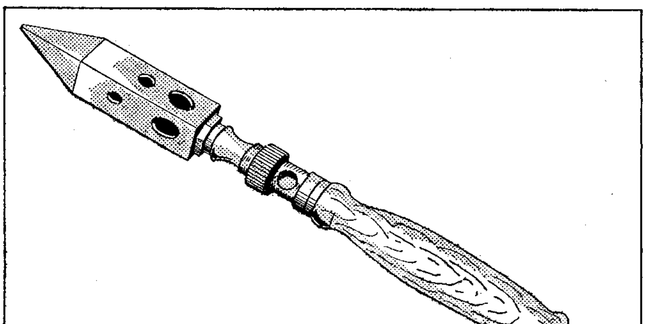


Fig. 3. A soldering-iron for use with Calor gas

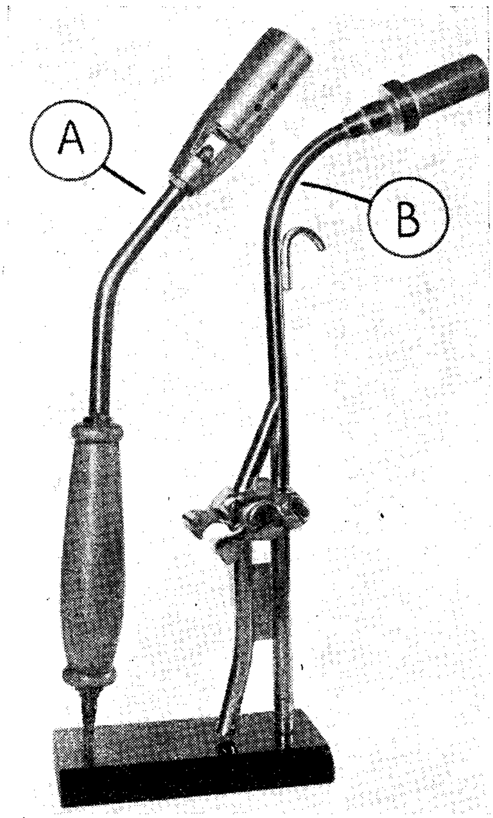


Fig. 4. Torches for use with Calor gas. " A "—torch for silver-soldering ; " B "—torch for brazing, using compressed air and gas at low pressure

Testing for Leaks

The most convenient method of testing an installation for leaks is to paint a soap solution over all unions, taps and any joints in the system. All taps in the pipe line are then closed. The gas is then turned on at the cylinder so that the system is under pressure. Any leaks that there may be will be revealed by the formation of bubbles in the soap solution covering the defective joint.

It must be emphasisted that the method described above applies only to simple installations such as are needed in the small workshop. When the installation is more complex the standard procedure for testing town gas equipment should be followed. These methods are fully described in standard text books on town gas.

Safety precautions to be observed when using Calor gas are the same as those normally associated with town gas. In addition, however, it must be remembered that, unlike town gas, Calor gas is twice as heavy as air. Any gas that leaks, therefore, will tend to accumulate at the lowest point in the vicinity of the escape. For this reason adequate ventilation of the installation is essential.

Apparatus

The range of apparatus obtainable for use with air at atmospheric pressure with Calor gas is wide and includes bunsen burners of three types operating with air at atmospheric pressure and gas at low pressure, brazing torches for use with air at atmospheric pressure and gas at high pressure, brazing torches using low-pressure gas and air at pressures of from 5-10 lb., and soldering irons of the self-heating type using air at atmospheric pressure and gas at a pressure of 11 in. water gauge.

It may be helpful if the various pieces of apparatus and their application are illustrated and described.

For low temperature or soft-soldering the soldering irons Nos. SPQ.43. 44 × 45 of the type illustrated in Fig. 3 are suitable, as are also bunsen burners Q.7 × 8.

For hard-soldering or silver-soldering " Calor " gas torches Q.34, Q.35 × Q.36, illustrated in Fig. 4A, are used. These torches operate with air at atmospheric pressure and gas at pressure from 2-6 p.s.i. Working at a higher gas pressure than the normal bunsen burner heat is liberated more

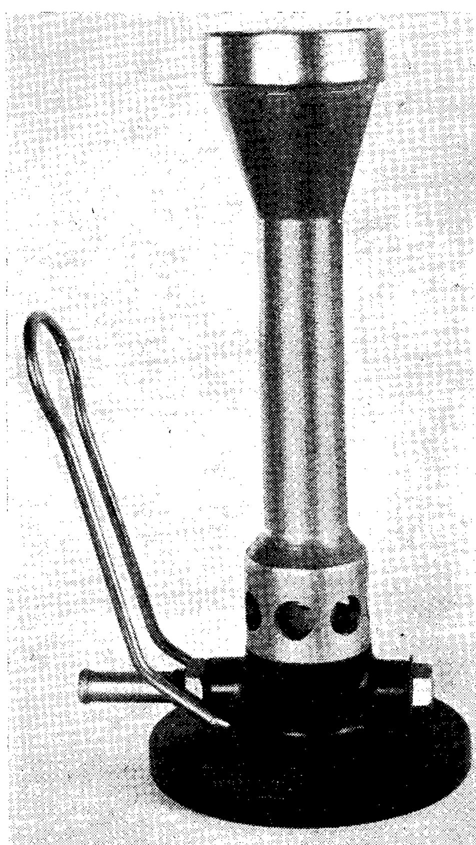


Fig. 5. The Amal bunsen burner for use with Calor gas

rapidly from the flame and higher flame temperatures are attained. The temperatures reached melt silver or hard solder freely.

For Brazing

When the work is light and the mass of metal to be heated to the fusion point of the brazing metal is small, the Q.36 torch will probably suffice. This torch at 5 lb. p.s.i. consumes 6-8 cu. ft. of gas per hour. Nearly twice the consumption of the next smaller torch.

For heavy brazing the Q.36 is *not* satisfactory but the "Wilkes/Calor/air" S.P.Q. torches will do this type of work. One of these torches is illustrated in Fig. 4B and they operate with gas at low pressure and air at pressures ranging from 5-10 lb.

The Amal bunsen burner illustrated in Fig. 5 is a useful appliance that may be obtained through any Calor gas stockist. It consists of a die-cast base of zinc alloy fitted with a connector for gas tubing and a wire handle for moving the burner about the bench. The base is also fitted with a brass adapter to take standard jets of a type similar to those found in motor-cycle carburettors. Three interchangeable jets are supplied together with a small T-handled box spanner for fitting them. By changing the jets the appliance may be used either with Calor gas at low pressure, 11 in. water gauge, or at high pressure, 2-5 lb. p.s.i. The vertical mixing tube, of chromium-plated steel, is flared at its top end and is supplied with a perforated metal diffuser for the bunsen flame.

The appliance may be used for many purposes in the workshop. It may be employed for heating soldering irons, for sweating work together, for tempering tools and, when used with a laboratory tripod, for heating glue-pots, or, in an emergency, boiling a kettle.

Comparative Tests of Apparatus

To provide some performance figures for purposes of comparison, tests were carried out with five Calor gas torches and also with a Primus No. 605 blowlamp having a fuel capacity of approximately two pints. The test applied consisted in measuring the time taken for each appliance to melt a ½ in. length of 12-gauge copper wire under similar conditions. The results of these tests are given in the table on the next page.

Fig. 6. Complete equipment for brazing by means of Calor gas

Equipment to be Provided by the User

So far, appliances obtainable from the Calor Gas Co. have been considered ; but, in addition to the various forms of torch that have been mentioned, the user must provide some form of brazing hearth, together with firebricks and fireclay cubes for packing around the work.

As well as providing himself with the above equipment, the operator will be well advised to make a simple adjustable clamp for holding

Appliance	Ref. No.	Gas Consumption	Time taken to melt test-piece
High Pressure Brazing Torch	Q.34	2.8 cu. ft. hour	30 sec.
High Pressure Brazing Torch	Q.35	3.9 " "	20 sec.
*No. 1 Blow Torch	SPQ. 4	1.5 " "	1 min.
*No. 2 Blow Torch	SPQ. 5	3.4 " "	30 sec.
*No. 3 Blow Torch	SPQ.26	6.2 " "	18 sec.
Primus No. 605 Blowlamp, two-pint ..	—	—	40 sec.

*These appliances are operated with compressed air.

the different torches when brazing is in progress.

Finally, if brazing torches using air under pressure are to be employed, an adequate air supply will be needed.

Brazing Hearths

In Fig. 6 the complete equipment for brazing and silver-soldering by Calor gas is illustrated. In this illustration will be seen the cylinder holding 83 lb. of gas, the high- and low-pressure reducing valves, together with their connecting piping and hoses, the complete brazing hearth with its air and gas control taps, and the adjustable clamp for holding brazing torches. A portable air-compressor suitable for use with the air-gas brazing torches is illustrated in Fig. 7.

The brazing hearth illustrated is contrived from a cabinet designed to hold machine tool operators' fine tools and equipment. This form of cabinet has a distinct advantage, for on the sliding shelves provided in the cupboard at the base may be kept all brazing appliances such as alternative torches, brazing spelter and silver solder, as well as the fluxes needed during the process.

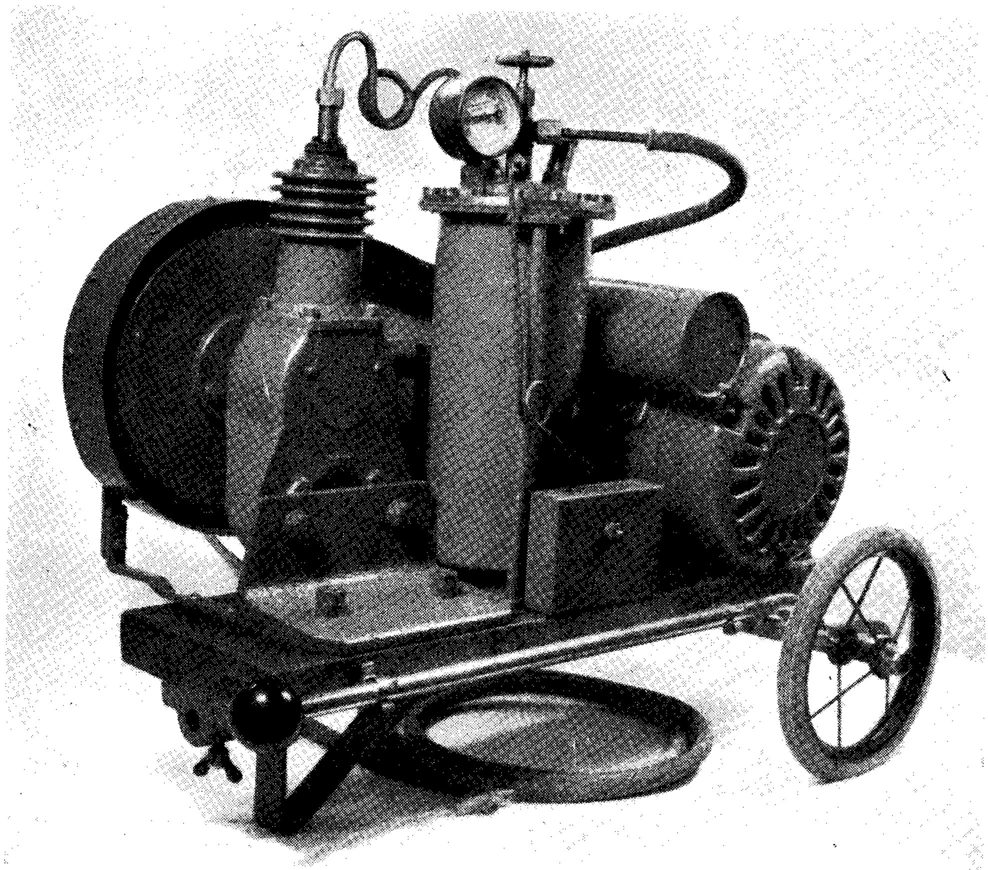


Fig. 7. An air compressor suitable for use with the brazing equipment

On the top of the cabinet is placed a tin baking tray holding two fireclay bricks measuring 12 in. × 8 in. These serve as a protection against the heat of the brazing operation and as a platform upon which to mount the work. The small squares seen on the firebricks are pieces of fireclay used to pack around the work so as to retain the heat. These fireclay cubes are obtainable from many tool merchants, and are greatly superior to coke that is apt to corrode work because of the sulphur liberated when the material is heated. It should be noted that cleanliness is of great importance in brazing and silver-soldering; this cleanliness must also be extended to the brazing hearth itself.

(To be continued)

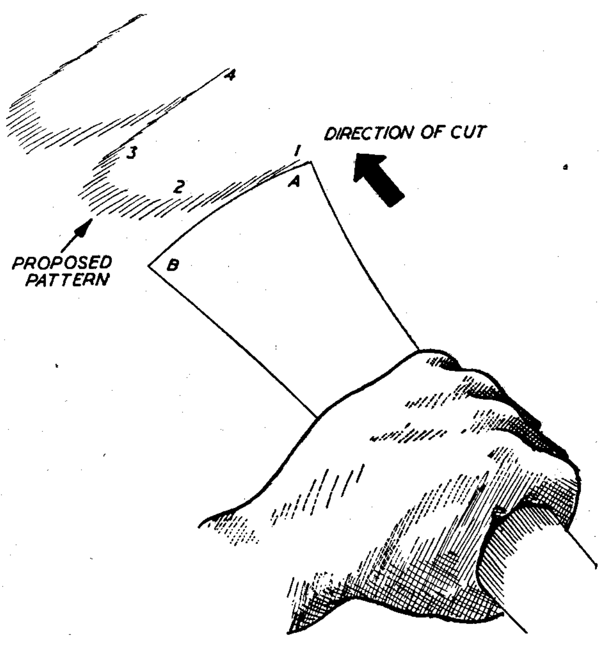
NOTES ON SCRAPING

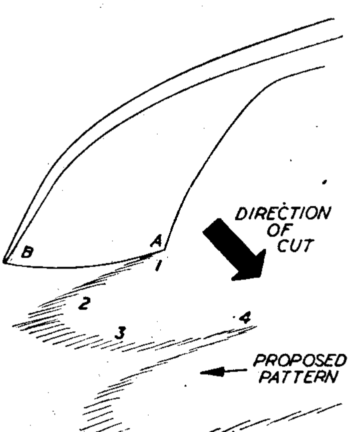
by A.E.U.

IN the issue of THE MODEL ENGINEER dated December 13th, 1951, Mr. Banyard asks for further information about scraping. It is very difficult to describe this process in words, as it is largely manipulative skill that produces the required results and this can only be acquired by practice. The diagrams and descriptions given here seem rather inadequate, but I trust they will be found helpful. The scraper is held down at *A* and rolled along its cutting edge to *B*, at the same time being moved forward, slowly at first, between the points 1 and 2, gaining momentum from 2 to 3 and slowing down as the scraper is rolled back from *B* to *A* between 3 and 4. Alternatively, the speed of traverse is kept constant and the speed of the rolling action varied. The pressure applied is lightest at *A* and heaviest at *B*. It sometimes helps to have the scraper slightly oblique to the line of travel.

The second diagram shows the method employed for producing the same results with a bent scraper, and a dragging action. These directions apply to either diagram.

The neat appearance of scraping is achieved by using the above action to remove single high-spots, and so give a feathered or frosted appearance to the surface. It is, however, a process that requires a lot of practice and manipulative ability, not to mention strong wrists.





Above—Diagram for drag or draw scraping

Left—Plan view over scraper's shoulder

*TWIN SISTERS
by J. I. Austen-Walton

Two 5-in. gauge locomotives, exactly alike externally but very different internally

Notes on paints, brushes and painting metals

I FULLY believe that most model builders would much rather build a model than paint it, and yet there is no valid reason why this part of the programme should present any terrors. I think if all would-be painters knew a little more about the characteristics of the various paints in everyday use, and some of the properties of the metals and materials to which they were going to apply the paints, they would set off in a much happier state of mind, and achieve much more praiseworthy results.

There are, of course, certain essentials in the way of working conditions and procedure that have to be observed rigidly, and, provided always that the operator carries out the work without undue hurry, or cuts out certain parts of the procedure in order to save time, he can obtain almost any degree of excellence by brush painting which will compare favourably with sprayed or stoved surfaces produced in much more luxurious and scientific conditions, and with all the up-to-date appliances associated with the industry. The main difference is time—a valuable commodity to the average model builder, but this is the only price he has to pay in order to succeed.

Two of the most common evils to both amateur and professional, are grease and dust. The amateur can rig up primitive but effective measures to combat both ; the professional resorts to more complicated but equally effective measures, and both work with the same object—to produce work that is as flawless as possible.

The Nature of Paint

All liquid paints are of a common two-part combination ; the pigment or solid matter that defines the colour, body or substance of the paint, and the excipient, medium or liquid part of the paint that alone provides the means of securing the mixture to the surface to be treated. The pigment part plays no part in this, except in the case of special paints that produce some sort of chemical or metallic bonding with the surface to which it is applied. If anything, a heavy or excessive quantity of pigment reduces the stability of a paint, and prevents the liquid medium forming a good " key " to the work surface.

With the exception of the cellulose types of paint, the excipient of oil-base paints may still further be divided ; the division is mild, the resultants still remaining in the same oil-base family. The oil is usually a drying oil—the drying being achieved purely by oxidisation, and the application of heat alone cannot to advantage hurry the drying process unless the applied heat hastens the *chemical* process involved. Commercial or domestic paints would be unpopular if they dried too slowly, so a drying agent such as terebene, turpentine or some other patent preparation is usually much in evidence. Turpentine is used also for thinning purposes ; its addition hastens rather than slows up the drying time. In recent years we have seen much more of the " high gloss " type of paint, developed along the lines of a " one coat " preparation, and which undoubtedly delights the housewife who wants to paint a chair one day, and sit on it the next. This is *not* a preparation for the model maker to use, as even the manufacturers agree.

Synthetic Paints

These have much in common with the oil-base paints, and the pigments used may be identical. The liquid parts are made from synthetic gums in liquid form, which respond to a rather more active and virile drying agent ; the process of oxidisation in free air, still determines the drying time in most cases, although some degree of artificial heat in addition to air exposure, hastens the process without detriment to the finish or durability of the paint. Quite a number of low-temperature stove enamels have been developed along these lines, and nearly all are synthetic in nature.

It must be remembered that paint is a specialised industry these days, and some synthetic paints are made with a view to withstanding the rigours of outside weather conditions, sea air, etc., but are not called upon to provide a high degree of elasticity ; for some other purposes, the qualities may, to advantage, be reversed, and these combinations of virtues may be varied in proportions according to makers' ideas, and the qualities of the materials used ; the price of the paint gives a fair clue to the latter. I have never advocated a cheap paint for model work, especially as the quantities used are relatively small.

Cellulose Paint

This, most people believe, scores its biggest success through its " sprayable " characteristics, and ultra-quick drying, and most certainly the motor-car industry found a good use for it. I would be the first to agree that most delightful and even finishes are obtained by using it, and for purely decorative purposes it is probably unequalled. Showcase models come into the class that lends itself to this treatment, but not hard working engines. Its resistance to heat, oil and grease, and finally, its clinging properties with metal fall, to my mind, very far off the

*Continued from page 62, " M.E." January 10, 1952.

mark. Even if excessive heat does not actually remove or flake the paint, severe discoloration is a serious problem to be taken into consideration. Even well-prepared wood surfaces do not take kindly to cellulose, as the car manufacturers found out with the wood flashings round the windows, and now many cars are finished throughout with a synthetic type of paint. Cellulose has its advantages and uses, however, because of its high density and relatively thin coat, even after more than one application, and it does not tend to hide " detail " in delicate work. Nothing looks worse than a row of rivet heads that are " swimming " in the middle of a thick mass of paint.

Do not run away with the idea that only cellulose paint is " sprayable." Nearly all liquid paints may be sprayed, although the technique used for oil base or synthetic paints is quite different and perhaps a little more difficult. I have sprayed all types of paint, including the highest grade of carriage varnish, and even if I didn't score a hit the first time, I soon tumbled to the technique required.

Paint and Metals

As most of us put our paint on to metal surfaces more than on any other type of material, let us consider certain facts connected with metals. Steel and cast-iron seldom give any trouble, although cast-iron that tends to be porous, and has been annointed frequently with paraffin or left hanging about in a tray of oil, may give us no end of trouble if it is not treated beforehand. Brass is probably one of the most difficult metals to prepare, followed by zinc—fortunately not much used in model work, and then some grades of aluminium in the softer varieties. It is interesting to note that most of the metals that are in the cast form, give less trouble than the sheet material ; it may well be due to some degree of porosity in the former which, if truly free from grease, helps rather than hinders paint key, and to some degree of over-finish in the latter. This over-finishing can be overcome in the building stage, and positively prevented in other ways. Never deliberately " buff " up bits and pieces that you know will be painted later on ; many builders succumb to this temptation, just in order to see how smart the item is going to look eventually.

All the metals respond well to treatment before painting but all scale and rust *must* be removed first, and so must every trace of grease. If a part to be painted is *really* greasy and oily, petrol will remove practically all of it ; but even this is not enough—a far more active agent is required to take away the last traces of grease. Of the materials available, carbon tetrachloride is perhaps the best, but ordinary commercial cellulose thinners or even synthetic thinners will make a thorough job of it.

Once this operation has been done, do not handle the part with your bare hands ; if you do, you will put back quite a lot of grease. It is a good plan to provide yourself with a pair of cheap cotton gloves to be used only during such operations, and not for the painting work ; these can be washed out from time to time, in one of the thinners used ; they may not come " clean " from the housewife's point of view, but, at least, they will be free from grease.

During the degreasing operation, take special care with metal joints, lapped and riveted joints in particular, because it is certain that some grease will be left trapped underneath ; submerging the whole article in a bath of thinners is the only way of making sure that the grease has been dissolved from everywhere, but for all general, everyday purposes, a generous wash in the thinners should be safe enough.

If the metal to be painted is sheet brass, one of the worst painting cases, it is possible to treat chemically the surface of the metal. A strong solution of perchloride of iron, painted or rubbed on to the metal will produce a good frosting of the surface, and one that will enhance the conditions important to paint " key." This should be well washed off afterwards, and the whole operation done either before or after degreasing.

Sheet steel will, in its natural state, take paint quite well, but highly polished steel should be " shot " or " sand blasted," a difficult and risky business with a finished article, but simple and straightforward when in the raw material form. Where there are no reasonable facilities for such treatment, a good rubbing down with *coarse* emery paper is the next best thing.

Paint and Brush

In your enthusiasm, you will probably start off with a new tin of paint and a brand new brush, both of which will be co-partners in a diabolical conspiracy to produce for you a nice knobbly and speckly finish. To start with, it says on the tin : " Strained ready for use " ; in spite of this, all paint should be strained before any attempt is made to use it. About three thicknesses of an old silk stocking, stretched over a *clean and dust-free glass jar* will usually remove any sediment from the paint, after which take off the stocking, and *cover up the jar at once.*

And the brush—all nicely covered up with a bit of cellophane and a rubber band ! I once thought this was to keep the brush clean, but I now believe that it is merely to keep the dust *in* !

A *good* quality brush that has been carefully used for a time, and maintained in a perfectly clean condition, is the best " tool " to use ; it has then got over its moulting habits and settled down. The only thing to do with a new brush is to wash it out in at least half a dozen *separate and distinct* doses of either petrol or turpentine, after which it may still further be improved by putting it to some actual painting job, using the type of paint with which it will live for the remainder of its useful life. By this I mean that there should be one or more brushes for cellulose, others for synthetic paints, and another department for oil paints.

Whilst on the subject of brushes, the stiffness of the bristles also has something to do with the type of finish produced ; the brush, when first bought, may appear to be much too stiff, but do not forget that it will work down to some extent when it has given a short period of service. A brush that has been cleaned and dried will, on the resumption of work, resume some of its intractable characteristics, though not for long. Some painters like to anticipate a job by soaking

brushes for some days before they are required ; it is a bad practice to allow a brush to *stand* in a jar of water, and with the bristles bending out under the weight of the brush ; *hang* it in water for short periods if you wish, but never leave it to its fate.

Cellulose paints of the brushing variety call for a very soft brush—even camel hair at times, and a technique that is the very reverse to that employed with oil base paints. The cellulose occupies a good deal of space when in the liquid form, but it dries away to an extremely thin coat. This calls for a full brush and a comparatively " swimming " coat, gently applied, and no repeated strokes over the areas just coated ; as a rule, the job looks an appalling mess for a few minutes, but soon settles down quite well as the thinners evaporate. Applying the second or third coat—nearly always necessary—produces its own problems, due to the ability of the thinners in the paint to dissolve the previous coat, no matter how long this has been dry and set.

The First Coats

Most paints are supplied with a correct undercoating, adjusted for colour amongst other things, and extra heavy with a dense, opaque pigment. Its purpose is to cover, fill and hide the surface underneath. It is an unfortunate fact that this combination of qualities does not provide one that best suits it to the all-important one of holding tight to metal ; the excipient or liquid part does this, and obviously a preponderance of pigment can only interfere with this essential function.

For normal painting purposes, its constitution is correct for all other reasons, for a number of coats of the preliminary preparation give enough deposited body for rubbing down to a clear, flat surface, free from flaws.

I have a feeling that I may be a bit unorthodox in my methods, but I have been able to satisfy the needs of the case by applying to the metal first of all, a *very* thin coat of the best and toughest varnish available. This is all excipient and no pigment, or, translated—all key and no cover. The cover can follow in the form of normal undercoating, the first coat of which should be applied just as soon as the thin varnish coat has passed the " tacky " stage ; to wait longer than this, produces a much harder skin to the varnish, and some of the problems of " key " begin to reappear.

The undercoating paint should be strained in the same way as the finishing paint, and in addition to this its consistency should be reduced considerably ; most people put the paint on much too thickly, and they get runs and all sorts of horrible things.

If the undercoating has to cover a multitude of sins, then a number of undercoatings may be necessary, as well as some preliminary stopping of deep pits or scratches. Heavy plastic stopping should be on top of the initial " key " coat, and care must be taken before any rubbing down is carried out to make sure that the rubbing does not go right through to the bare metal, removing the foundation " key " at the same time.

I think I ought to repeat the old, old warning ; let *each and every coat dry thoroughly* before applying the next, and please refrain from the all-too-frequent habit of dabbing with the finger to see if the paint is still wet—it *is* still wet, and there is the mark to prove it.

Air and Dust

Air, that is in lively circulation, is full of dust, and we have to take steps to keep away from places where traffic, draughts and disturbances keep the dust briskly in circulation. A good place for painting is in a room at the top of the house (good news for bungalow dwellers), where the disturbances of street traffic are not so likely to be found. Generally, wet weather is a good time for painting although the drying process is delayed a little.

The dust problem will not be serious in the undercoating stage, but when we come to the finishing coats it will pay us to take even further precautions, and here are some of them. Provide some sort of cover for the work, to be put in place immediately the paint has been applied. A sheet of glass, supported by all four corners, or even smooth, clean cardboard. If there is a table covering, such as a cloth or blanket, remove this or, alternatively, make it slightly damp. Do not work with a coal fire in the room ; substitute an electric fire if possible. Have the window closed except for a small opening at the top ; in addition, hang a wet cloth in front of it. If you have an airing horse or screen in the house, stand this round the table or bench, and cover it with wet drapings. Do not work in your jacket—the sleeves release dust which settles on the work ; in fact, avoid any loose, floppy clothing. If you have made the workshop the scene of operations, sprinkle concrete floors with water, or dress a wood floor gently with a fine watering can, and repeat as often as necessary.

All these precautions may be inconvenient and irksome, but they are the price you have to pay for good paintwork, and even then the finished article may produce a number of tiny pips and bumps to spoil the finish. If the job fails to come right up to the required standard, the best plan is to let the final coat harden right out ; rub it down with fine pumice or ultra-fine glass paper, and apply a final, *final* coat—and so on, up to about four attempts, after which it might be inadvisable to go on, to avoid the risk of getting detailed parts " blurred."

Most of the synthetic paints lend themselves to rubbing down far better than the oil base paints, and if the gloss of the final coat has been destroyed in the process of rubbing, it may readily be restored (if desired) through the use of metal polish or some of the well-known car polishes ; almost any degree of lustre can be achieved in this way, and small pips and blemishes disappear at the same time.

I do not propose to go into the general technique of spray painting because, with this method, most of the problems of good painting quite largely and automatically disappear, even if other snags take their place. Apart from this, painting in all its classes, is a big subject to which, in this short article, I can give only brief and sketchy attention. For the same reasons, some of the popular grades of low-temperature stoving

paints would certainly deserve a small book on their own, for their use entails equipment that does not form the usual part of the model maker's gear.

At least, I feel I have been able to cover the main points in this short treatment; many of the points given, you knew all along, but for some reason you never carried them out; perhaps you will now consider them again, or whenever the problem of good paintwork raises its ugly and inconvenient head.

(To be continued)

PRACTICAL LETTERS

Stephenson's "Atlas"

DEAR SIR,—If Mr. Eric W. Payter has access to *A Century of Locomotive Building*, Robert Stephenson & Co. Ltd., Darlington, by J. G. H. Warren, he will find what he wants on page 314 which gives a dimensioned drawing of the locomotive. The works drawing is dated September, 1833. It is numbered 58; but is unnamed. Mr. Warren describes it as the piston-type of the English six-coupled goods engine. It was built for the Leicester & Swannington Railway in 1834.

Yours faithfully,

Burton-on-Trent. (REV.) W. F. OAKLEY.

A Beginner's First Attempt

DEAR SIR,—I think the photograph here reproduced may interest some of our less advanced readers, being the result of a first attempt to deal with a nice set of castings sent me by Stuart Turner Ltd. It is, of course, the Stuart No. 10 high speed engine, $\frac{3}{4}$ in. bore by $\frac{3}{4}$ in. stroke.

After browsing through a few copies of THE MODEL ENGINEER last winter, the desire to do things with a lathe came upon me. About Christmas time a "Rollo Elf" lathe came my way, this was the hand-driven model, height of centres $2\frac{1}{2}$ in. and admitting $6\frac{1}{4}$ in. between centres.

Some time was spent indexing the leadscrew and cross-slide and making some of the useful tools described in your pages, such as the centre finder.

In the book of words supplied with the Stuart engine, I see it was assumed that the builder had gained sufficient experience to machine and fit the various parts together, and experience I had not!

Further reference to old copies of THE MODEL ENGINEER proved of great value, and a start was made.

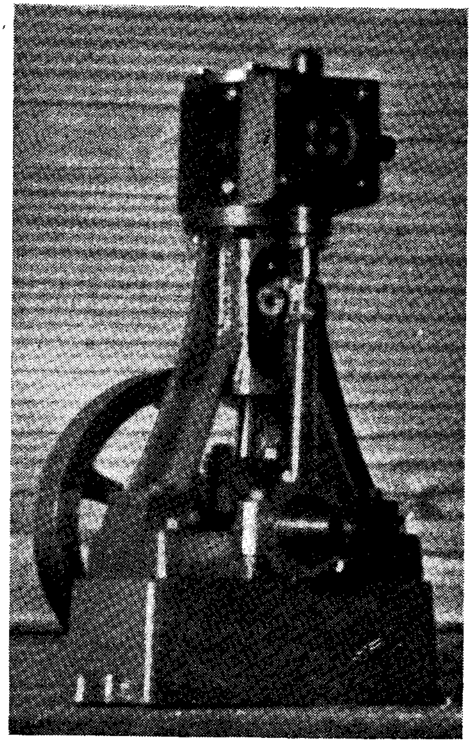
I found it no great disadvantage having only one hand to operate the lathe, the other, of course, turning the crank handle; in fact, it now seems to me an ideal arrangement for the novice. It was easy to feel when things were going wrong and stop immediately before any damage was done.

How to turn and bore the standard bothered me at first, but after facing off the feet by mounting the standard on a mandrel, I reversed it and attached the feet to the carrier plate by four little "C" clamps made from steel nuts.

Turning the crankshaft was fun, done in the approved manner between centres, and the lathe stood up well to the machining of the flywheel.

The cylinder ends, port and steam chest faces were all filed and brought perfectly flat by rubbing on emery-cloth on plate glass.

On assembly, I found I had play at the gudgeon-pin through the crosshead and also at the little-end of the eccentric, and realised I had cheerfully put clearing size drills through. The crosshead gudgeon-pin hole was reamed and a small



phosphor-bronze bush turned up and bored with a minute boring tool made from silver-steel rod; and an oversize pin put through the eccentric little-end, and now all seems well.

I have yet to make a boiler, but with a trial run on compressed air, the engine turned over very sweetly.

Yours faithfully,

Kingsbridge. J. C. PLANT.